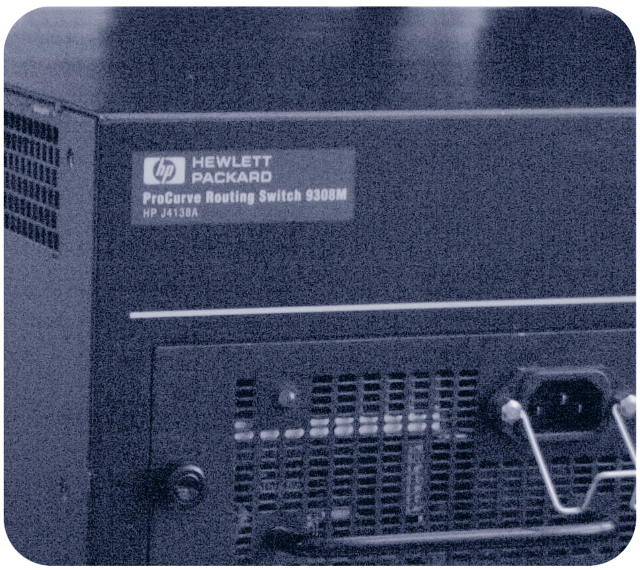
advanced configuration and management guide

i n v e n t



hp procurve routing switches 9304m, 9308m, and 6308m-sx

and the **hp** procurve switch 6208m-sx

(software release 6.6.*x* and 7.1.*x*)

www.hp.com/go/**hp**procurve

Book 2:

Advanced Configuration and Management Guide

for the **HP ProCurve Routing Switches**

9304M, 9308M, 6308M-SX

and the **HP ProCurve Switch 6208M-SX**

(Software Releases 6.6.*X* and 7.1.*X*)

Publication number

5969-2363

December 2000

Applicable Products

HP J4138A, HP J4139A, HP J4840A, HP J4841A

Trademark Credits

Microsoft®, Windows®, Microsoft Windows NT® and Internet Explorer® are U.S. trademarks of Microsoft Corporation. Netscape® Navigator is a U.S. trademark of Netscape Communications Corporation. Cisco® is a trademark of Cisco Systems Inc.

Disclaimer

The information contained in this document is subject to change without notice.

HEWLETT-PACKARD COMPANY MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS MATERIAL, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Hewlett-Packard shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance or use of this material.

Hewlett-Packard assumes no responsibility for the use or reliability of its software on equipment that is not furnished by Hewlett-Packard.

A copy of the specific warranty terms applicable to your HP product and replacement parts can be obtained from your HP Sales and Service Office or authorized dealer.

Warranty

See the Customer Support and Warranty booklet included with the product.

A copy of the specific warranty terms applicable to your Hewlett-Packard products and replacement parts can be obtained from your HP Sales and Service Office or authorized dealer.

Safety Considerations

Prior to the installation and use of this product, review all safety markings and instructions.

Instruction Manual Symbol.

If the product is marked with the above symbol, refer to the product manual to protect the product from damage.

WARNING Denotes a hazard that can cause injury.

CAUTION Denotes a hazard that can damage equipment or data.

Do not proceed beyond a **WARNING** or **CAUTION** notice until you have understood the hazard and have taken appropriate precautions.

Use of control, adjustments or performance procedures other than those specified herein may result in hazardous radiation exposure.

Grounding

This product provides a protective earthing terminal. There must be an uninterrupted safety earth ground from the main power source to the product's input wiring terminals, power cord or supplied power cord set. Whenever it is likely that the protection has been impaired, disconnect the power cord until the ground has been restored.

If your LAN covers an area served by more than one power distribution system, be sure their safety grounds are securely interconnected.

LAN cables may occasionally be subject to hazardous transient voltages (such as lightning or disturbances in the electrical utilities power grid). Handle exposed metal components of the network with caution.

For more safety information, see "Safety and EMS Regulatory Statements" in the *Installation and Getting Started Guide*.

Servicing

There are no user-serviceable parts inside the user-installable modules comprising the product. Any servicing, adjustment, maintenance or repair must be performed only by service-trained personnel.

Organization of Product Documentation

Read Me First

The “Read Me First” document includes software release information, a brief “Getting Started” section, an accessory parts list, troubleshooting tips, operating notes, and other information that is not included elsewhere in the product documentation.

NOTE: HP periodically updates *Read Me First*. The latest version is available at **http://www.hp.com/go/hpprocurve**. (Click on **Technical Support**, then **Manuals**.)

Main Product Coverage

The main product documentation for your switch or routing switch includes:

- *Book 1: Installation and Getting Started Guide*. Book 1 contains the product Safety and EMC Regulatory statements as well as installation, security, and basic configuration information. A printed copy of this guide is included with your HP product. An electronic copy is also included as a PDF (Portable Document Format) file on the CD shipped with your HP product.
- *Book 2: Advanced Configuration and Management Guide*. Book 2 (this manual) contains advanced configuration information for routing protocols, Spanning Tree Protocol (STP), Quality of Service (QoS), and Virtual LANs (VLANs). In addition, appendixes in this guide contain reference information for network monitoring, policies and filters, and software and hardware specifications. This manual is included in a PDF (Portable Document Format) file on the CD shipped with your HP product.
- *Book 3: Command Line Interface Reference*. Book 3 provides a dictionary of CLI commands and syntax. An electronic copy of this reference is included as a PDF (Portable Document Format) file on the CD shipped with your HP product.

These documents also are available in PDF file format on HP's ProCurve website.

NOTE: In Book 2, most of the chapters apply only to the HP 9304M, HP 9308M, and HP 6308M-SX routing switches (and not the HP 6208M-SX switch). However, the QoS, ACL, STP, and VLAN chapters, and appendixes A and B apply to the HP 6208M-SX switch as well as the routing switches.

Product CD: A Tool for Finding Specific Information and/or Printing Selected Pages

This CD is shipped with your HP product and provides the following:

- A **README.txt** file (or **README.pdf** file) describing the CD contents and use, including easy instructions on how to search the book files for specific information
- A **contents.pdf** file to give you easy access to Book 1, Book 2, and the CLI Reference on the CD
- Separate PDF files of the individual chapters and appendixes in Book 1 and Book 2, enabling you to easily print individual chapters, appendixes, and selected pages
- Single PDF files for each of the books, enabling you to use the Adobe® Acrobat® Reader to easily search for detailed information
- An Adobe Acrobat Reader (in case you don't already have a reader installed on your PC)
- Additional files. These may include such items as a copy of the device software (OS), additional Readme files, and updates to network management software (HP TopTools for Hubs & Switches).

Supplements and Release Notes

These documents describe features that became available between revisions of the main product documentation. Depending on when new features are released, you may or may not receive any supplements or release notes with your HP product. New releases of such documents will be available on HP's ProCurve website. To register to receive email notice from HP when a new software release is available, go to **http://www.hp.com/go/hpprocurve** and click on **Technical Support**, then **Software**.

Contents

Chapter 1
Getting Started

Introduction

This guide describes how to install, configure, and monitor the following devices:

- HP ProCurve Routing Switch 9308M
- HP ProCurve Routing Switch 9304M
- HP ProCurve Routing Switch 6308M-SX
- HP ProCurve Switch 6208M-SX

This guide also describes how to monitor these products using statistics and summary screens.

Audience

This guide assumes that you have a working knowledge of Layer 2 and Layer 3 switching and routing. You also should be familiar with the following protocols if applicable to your network—IP, RIP, OSPF, BGP4, IGMP, PIM, DVMRP, IPX, AppleTalk, SRP, and VRRP.

Nomenclature

This guide uses the following typographical conventions:

Italic	highlights the title of another publication and occasionally emphasizes a word or phrase.
Bold	highlights a CLI command.
Bold Italic	highlights a term that is being defined.
<u>Underline</u>	highlights a link on the Web management interface.
Capitals	highlights field names and buttons that appear in the Web management interface.

NOTE: A note emphasizes an important fact or calls your attention to a dependency.

WARNING: A warning calls your attention to a possible hazard that can cause injury or death.

CAUTION: A caution calls your attention to a possible hazard that can damage equipment.

Terminology

The following table defines basic product terms used in this guide.

Product Terms

Term	Definition
chassis or **Chassis device**	A switch or routing switch that accepts optional modules or power supplies.
fixed-port device	A device that contains a fixed configuration of ports, instead of swappable modules. The HP 6208M-SX switch and HP 6308M-SX routing switch are fixed-port devices.
routing switch or **router**	A Layer 2 and Layer 3 device that switches and routes network traffic. The term *router* is sometimes used in this document in descriptions of a routing switch's Layer 3 routing protocol features.
switch	A Layer 2 device that switches network traffic.
`HP9300` or **`HP6208`** or **`HP6308`**	An example Command Line Interface (CLI) prompt. Actual prompts show the product number for the device, such as `HP9304`.

Related Publications

The following product documentation is available for your HP switch or routing switch:

- ***Read Me First*** *for the* HP *ProCurve Routing Switches 9304M, 9308M, and 6308M-SX, and the HP ProCurve Switch 6208M-SX*—This document includes software update information, the parts list for your HP ProCurve device, and other product information. Updates to this document are published on the World Wide Web from time to time, and may include additional troubleshooting, errata, and operating notes. To check for the latest version of *Read Me First*, go to **www.hp.com/go/hpprocurve**, select **Technical Support**, and then **Manual**s.
- ***Book 1: Installation and Getting Started Guide***. Book 1 contains the product Safety and EMC Regulatory statements as well as installation, security, and basic configuration information. A printed copy of this guide is included with your HP product. An electronic copy is also included as a PDF (Portable Document Format) file on the CD shipped with your HP product.
- ***Book 2: Advanced Configuration and Management Guide***. Book 2 contains advanced configuration information for routing protocols, Spanning Tree Protocol (STP), Quality of Service (QoS), and Virtual LANs (VLANs). In addition, appendixes in this guide contain reference information for network monitoring, policies and filters, and software and hardware specifications. This manual is included in a PDF (Portable Document Format) file on the CD shipped with your HP product.
- ***Book 3:*** HP ***ProCurve Command Line Interface Reference***. The Command Line Interface Reference provides a dictionary of CLI commands and syntax. An electronic copy of this reference is included as a PDF (Portable Document Format) file on the CD shipped with your HP product.
- ***Documentation CD for the HP ProCurve Routing Switches 9304M, 9308M, 6308M-SX, and the HP ProCurve Switch 6208M-SX***—This CD contains PDF files for Book 1, Book 2, and Book 3, and provides a

method for electronically searching either individual chapters or an entire manual for specific topics. For a brief description of the CD contents and how to use the CD to save time, do the following:

1. Insert the CD in your PC's CD-ROM drive.
2. Using the file manager in your PC, select the drive containing the CD and display the CD's directory.
3. Use a compatible text editor to display the **README.txt** file in the CD's root directory.

- **Manual Supplement**—These documents are included with your HP device if the software shipped with the device includes feature upgrades that were added after the last revision of the manual. They are also included with software upgrades when available on the World Wide Web. To check for the latest software version, go to **www.hp.com/go/hpprocurve** and click on **Technical Support**, then **Software**.
- **Support is as Close as the World Wide Web!**—Included with your HP switch or routing switch, this document is a guide to HP support services and also provides information on your HP networking product warranty.

What's New in this Edition?

This edition and the October 2000 editions of the *Installation and Getting Started Guide* and *Command Line Interface Reference* contain descriptions of the new features listed below. (For features added in later, minor releases – after November, 2000 – see the latest release notes in the Technical Support | Manuals area at **http://www.hp.com/go/hpprocurve**.)

Enhancements Added in Software Release 06.6.X

The following enhancements are new in software release 06.6.*X* and higher. All of these enhancements also are present in software release 07.1.*X*.

System-Level Enhancement

- Secure management access based on VLAN ID

Enhancements Added in Software Release 07.1.X

The following enhancements are new in software release 07.1.*X*. These enhancements are present only in software release 07.1.*X*. They are not supported in software release 06.6.*X*.

Layer 3 Enhancements

- Support for up to 10,000 static ARP entries
- Aggregate default network routes
- Host-based IP load sharing for specific destination networks
- ICMP Router Discovery Protocol (IRDP) enhancements
- Option to disable ICMP redirect
- RIP offset lists
- More flexible IP multicast interface numbering
- Hardware forwarding for all fragments of IP multicast packets
- Multicast Source Discovery Protocol (MSDP)
- Dynamic OSPF memory
- Support for up to 32 OSPF area ranges in each area
- Support for up to 25,000 External LSAs
- OSPF group Link State Advertisement (LSA) pacing
- External LSA reduction

- BGP4 re-advertises BGP routes even when OSPF or RIP routes to the same destination have a lower cost
- Redistribution changes take place immediately
- Option to redistribute Internal BGP (IBGP) routes into RIP and OSPF
- Dynamic BGP4 route refresh
- BGP4 route reflection updated to RFC 2796
- Change to route map processing of ACL or other filtering deny statements
- Option to clear BGP4 neighbor sessions based on a specific Autonomous System (AS) number.
- You can specify a route map name when configuring BGP4 network information
- Enhancements to set metric command in route maps
- Enhancements to show ip bgp commands
- Enhancement to BGP4 Syslog message
- Network Address Translation (NAT)
- Virtual Router Redundancy Protocol Extended (VRRPE)
- ICMP Router Discovery Protocol (IRDP) is disabled by default
- Policy-Based Routing (PBR)
- Support for standard static IP routes and interface or null static routes to the same destination
- Dynamic memory for BGP4
- BGP4 peer groups
- New BGP4 show commands
- Enhanced BGP4 show commands for neighbor information

Layer 2 Enhancements

- Updated STP port Path Cost defaults
- Compatibility with Cisco Systems' Per VLAN Spanning Tree (PVST)

System-Level Enhancements

- Enhanced software version information
- New strict mode for ACL processing of UDP traffic
- Fixed Rate Limiting
- Adaptive Rate Limiting
- Denial of Service (DoS) protection for TCP SYN and ICMP transit traffic
- Authorization and Accounting support for RADIUS and TACACS+
- TACACS+ password prompt support
- VLAN-based management access control
- RSA authentication for SSH
- SCP support for secure file transfers
- Automatic load re-distribution following a healed trunk link
- Support for up to 4095 VLANs and up to 4095 virtual interfaces (VEs)
- VLAN and virtual interface groups
- Enhanced CLI for managing redundant management modules

- Super Aggregated VLANs
- Support for simultaneous Telnet configuration by multiple users
- New CLI command for displaying dynamic memory utilization
- SNMP V2 view
- Enhancement to show default values command
- CLI enhancements to the startup-config and running-config files
- Page display is configurable for individual CLI management sessions
- CLI enhancement to display the idle time for open CLI sessions
- New CLI command for displaying TACACS+ or RADIUS information
- Enhancement to the show web command
- New option for setting the timeout for Telnet sessions
- Enhancements to show interface command
- ACL configuration supported in the Web management interface
- Greeting banners are displayed at the beginning of a Web management session
- Increasing the Syslog buffer size does not clear entries
- The newline character does not appear in Syslog and SNMP trap messages
- New MIB tables for Adaptive Rate Limiting
- Support for Secure Shell (SSH) for remote access to the CLI
- Support up to 12 trunk groups on 24-port 10/100 modules
- Strict ACL TCP mode
- Support for per-port ACL assignment within a virtual interface's VLAN
- New commands for copying files between a device's flash memory and a TFTP server
- Change to the IP address used when you enable the routing switch to use a single IP address on the device as the source for all Telnet, RADIUS, or TACACS/TACACS+ packets originated by the device
- Option to suppress Telnet connection rejection message
- Configurable block size for TFTP file transfers

Support and Warranty Information

Refer to *Support is as Close as the World Wide Web*, which was shipped with your HP switch or routing switch.

Chapter 2
Quality of Service (QoS)

Software release 06.6.*X* provides the following enhancements to QoS on the HP 9304M, HP 9308M, and HP 6208M-SX routing switches.

- You can choose between a strict queuing method and a weighted queuing method.
- You can modify the minimum guaranteed percentage of bandwidth for each queue.
- You can apply a QoS profile (one of the four queues) to 802.1q tagged VLAN packets.
- You can display the percentage of an uplink's bandwidth that each of a given set of ports uses. This is especially useful in environments where collocated customers on different, isolated ports share common uplink ports.

These new features add flexibility to the QoS features in earlier software releases but do not replace them.

The Queues

HP 9304M, HP 9308M, and HP 6208M-SX routing switches use the following queues:

- qosp3 – The highest priority queue. This queue corresponds to 802.1p prioritization levels 6 and 7 and HP priority levels 6 and 7.
- qosp2 – The second-highest priority queue. This queue corresponds to 802.1p prioritization levels 4 and 5 and HP priority levels 4 and 5.
- qosp1 – The third-highest priority queue. This queue corresponds to 802.1p prioritization levels 2 and 3 and HP priority levels 2 and 3.
- qosp0 – The lowest priority queue. This queue corresponds to 802.1p prioritization levels 0 and 1 and HP priority levels 0 and 1.

The queue names listed above are the default names. You can rename the queues if you want, as described in "Renaming the Queues" on page 2-4".

- You can classify packets and assign them to specific queues based on the following criteria:
  - Incoming port (sometimes called ingress port)
  - IP source and destination addresses
  - Layer 4 source and destination information (for all IP addresses or specific IP addresses)
  - Static MAC entry
  - AppleTalk socket number
  - Layer 2 port-based VLAN membership
  - 802.1q tag

By default, all the traffic types listed above except the 802.1q tagged packets are in the best effort queue, which is the lowest priority queue. The 802.1q tagged packets are assigned to a queue based on the priority level (0 – 7) in the packet's tag. The default mapping of the priority levels to the queues is as follows.

Priority Level	Queue
6, 7	qosp3
4, 5	qosp2
2, 3	qosp1
0, 1	qosp0

In cases where a packet matches more than one traffic type, the highest queue level among the traffic type is used. For example, if a tagged packet arrives on a tagged port and the 802.1p priority is 4 (qosp2) but the packet contains IP source and destination information that matches an IP access policy configured to assign the traffic to priority 7 (qosp3), the device places the packet in qosp3 of the outbound port.

Automatic Queue Mapping for IP Type Of Service (TOS) Values

HP devices that support QoS automatically examine the first two bits in the Type of Service (TOS) header in each IP packet as it enters the device on a 10/100 port. The device then places the packet in the QoS queue that corresponds to the TOS value.

The TOS value in the first two bits can be one of the following.

TOS value (binary)	Queue
11	qosp3
10	qosp2
01	qosp1
00	qosp0

As the packet moves through the system, if the packet matches other QoS allocations you have configured, the packet is moved into a higher queue accordingly. For example, if the TOS values place the packet in qosp1, but the packet is part of a port-based VLAN that is in qosp3, the packet enters queue qosp3. Packets can enter higher queues but never enter lower queues as they move through the system.

Queuing Methods

In software release 06.6.*X* and higher, you can configure the device to use one of the following queuing methods:

- Weighted – A weighted fair queuing algorithm is used to rotate service among the four queues. The rotation is based on the weights you assign to each queue. This is the default queuing method and uses a default set of queue weights. This method rotates service among the four queues, forwarding a specific number of packets in one queue before moving on to the next one.

  The number of packets serviced during each visit to a queue depends on the percentages you configure for the queues. The software automatically converts the percentages you specify into weights for the queues.
- Strict – The software assigns the maximum weights to each queue, to cause the queuing mechanism to serve as many packets in one queue as possible before moving to a lower queue. This method biases the queuing mechanism to favor the higher queues over the lower queues. For example, strict queuing processes as many packets as possible in qosp3 before processing any packets in qosp2, then processes as many packets as possible in qosp2 before processing any packets in qosp1, and so on.

Selecting the Queuing Method

The HP 9304M, HP 9308M, and HP 6208M-SX routing switches and the HP 6208M-SX switch use the weighted fair queuing method of packet prioritization by default. To change the method to strict queuing or back to weighted fair queuing, use one of the following methods.

USING THE CLI

To change the queuing method from weighted fair queuing to strict queuing, enter the following commands:

```
HP9300(config)# qos mechanism strict
HP9300(config)# write memory
```

Syntax: [no] qos mechanism strict | weighted

To change the method back to weighted fair queuing, enter the following commands:

```
HP9300(config)# qos mechanism weighted
HP9300(config)# write memory
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the Weighted or Strict radio button next to QoS.
3. Click the Apply button to save the change to the device’s running-config file.
4. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Configuring the Queues

Each of the four queues has the following configurable parameters:

- The queue name
- The minimum percentage of a port’s outbound bandwidth guaranteed to the queue.

Renaming the Queues

The default queue names are qosp3, qosp2, qosp1, and qosp0. You can change one or more of the names if desired. To do so, use one of the following methods.

USING THE CLI

To rename queue qosp3 (the premium queue) to “92-octane”, enter the following commands:

```
HP9300(config)# qos name qosp3 92-octane
HP9300(config)# write memory
```

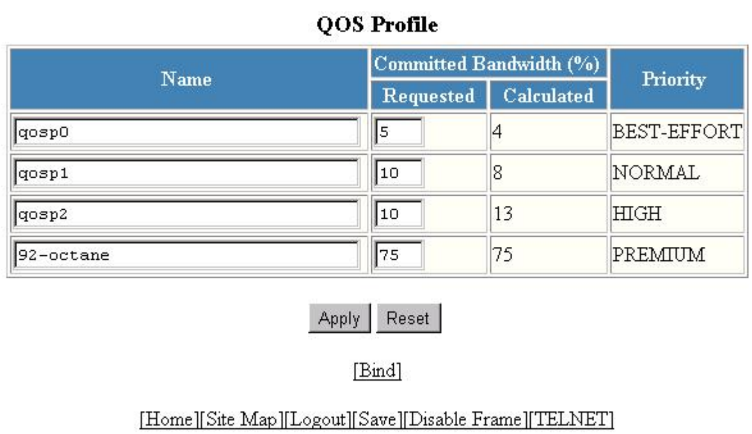
Syntax: qos name <old-name> <new-name>

The <old-name> parameter specifies the name of the queue before the change.

The <new-name> parameter specifies the new name of the queue. You can specify an alphanumeric string up to 32 characters long.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to QoS in the tree view to expand the list of QoS option links.
4. Click on the Profile link to display the QoS Profile configuration panel, as shown in the following figure.



5. Edit the strings name the Name fields for the queue(s) you want to rename. In this example, the premium queue is renamed from “qosp3” to “92-octane”.
6. Click the Apply button to save the change to the device’s running-config file.
7. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Changing the Minimum Bandwidth Percentages of the Queues

If you are using the weighted fair queuing mechanism instead of the strict mechanism, you can change the weights for each queue by changing the minimum percentage of bandwidth you want each queue to guarantee for its traffic.

By default, the four QoS queues receive the following minimum guaranteed percentages of a port's total bandwidth.

Queue	Default Minimum Percentage of Bandwidth
qosp3	80%
qosp2	15%
qosp1	3.3%
qosp0	1.7%

NOTE: The percentages are guaranteed minimum bandwidth percentages. Thus, they apply when a port is fully utilized. When a port is not fully utilized, it is possible for queues to receive more than the configured percentage of bandwidth. You cannot specify a maximum bandwidth percentage for a queue. Any queue can get more than its committed share when other queues are idle.

When the queuing method is weighted fair queuing, the software internally translates the percentages into weights. The weight associated with each queue controls how many packets are processed for the queue at a given stage of a cycle through the weighted fair queuing algorithm.

For example, the default percentages shown above translate into the following weights.

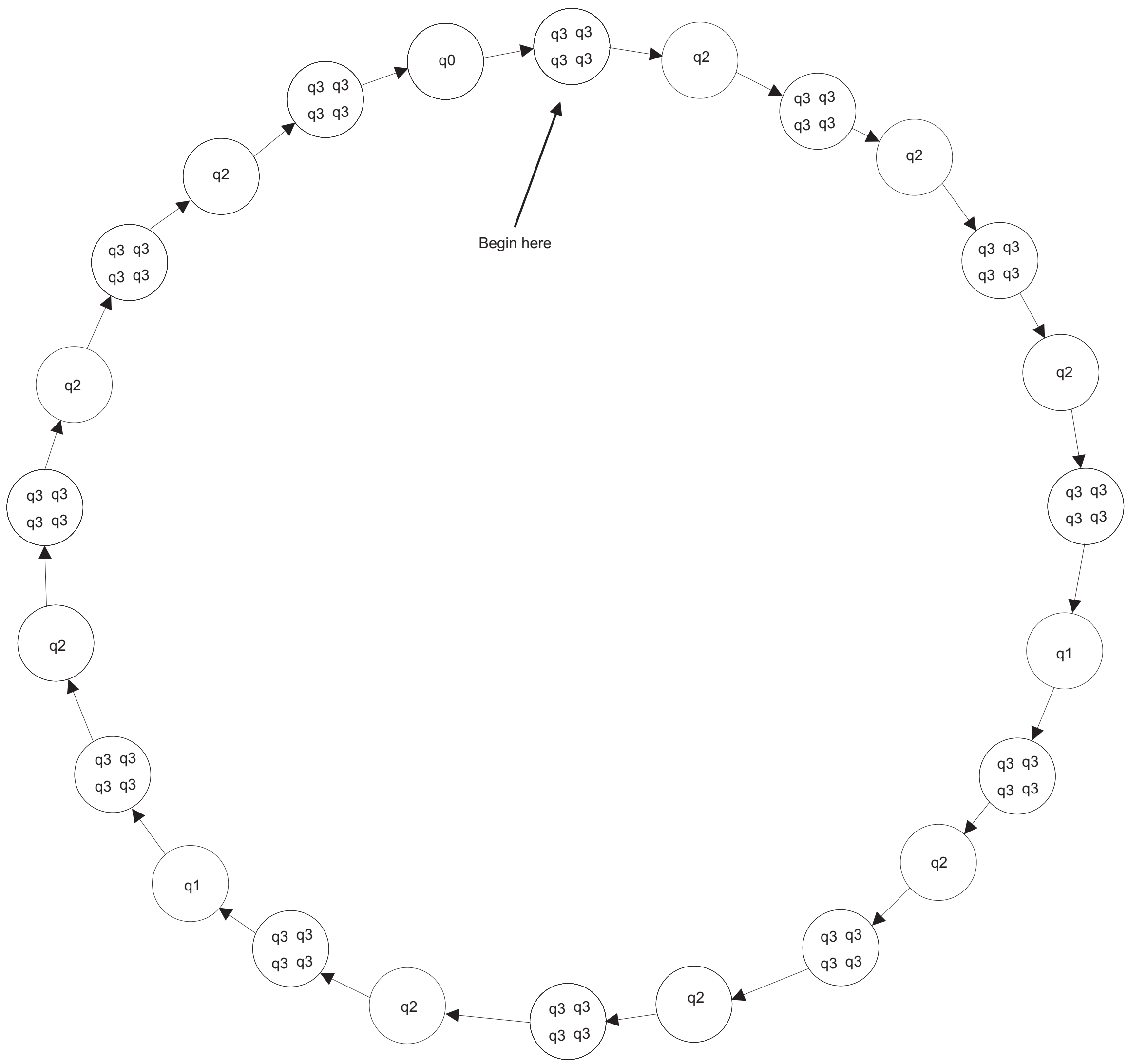
Queue	Default Minimum Percentage of Bandwidth	Queue Weight
qosp3	80%	4
qosp2	15%	3
qosp1	3.3%	2
qosp0	1.7%	1

A queue's weight specifies how many packets are sent from the queue each time the queue is serviced. Thus, when the default bandwidth percentages are used, four packets are sent from queue qosp3 each time the queue is serviced, while three packets are sent from queue qosp2 each time it is serviced, and so on. The queuing mechanism interleaves the queues during the cycle so that queue qosp3 is serviced after each visit to any other queue. For example, using the default percentages (and thus the default weights), queue qosp3 receives 12 visits for every one visit to queue qosp0.

The following table shows one full queue cycle using the default bandwidth percentages.

qosp3 bandwidth % = 80 weight = 4		qosp2 bandwidth % = 15 weight = 3		qosp1 bandwidth % = 3.3 weight = 2		qosp0 bandwidth % = 1.7 weight = 1	
Total visits	**Total packets**	**Total visits**	**Total packets**	**Total visits**	**Total packets**	**Total visits**	**Total packets**
1	4		1				
2	8		2				
3	12	1	3				
4	16				1		
5	20		4				
6	24		5				
7	28	2	6				
8	32			1	2		
9	36		7				
10	40		8				
11	44	3	9				
12	48					1	1

Figure 2.1 illustrates a cycle through the queues.



Queue 3: weight=4, minimum percentage=80%

Queue 2: weight=3, minimum percentage=15%

Queue 1: weight=2, minimum percentage=3.3%

Queue 0: weight=1, minimum percentage=1.7%

Figure 2.1 Example of a QoS cycle using the default weights

If you change the percentages for the queues, the software changes the weights, which changes the number of visits a queue receives during a full queue cycle and also the number of packets sent from each queue during each visit. For example, if you change the percentages so that queue qosp3 receives a weight of 5, then the system processes five packets in that queue during each visit to the queue.

NOTE: The weighted fair queuing method is based on packet-level scheduling. As a result, a queue's bandwidth percentage does not necessarily reflect the exact bandwidth share the queue receives. This is due to the effects of variable size packets.

USING THE CLI

To change the minimum guaranteed bandwidth percentages of the queues, enter commands such as the following. Note that this example uses the default queue names.

```
HP9300(config)# qos profile qosp3 75 qosp2 10 qosp1 10 qosp0 5
Profile qosp3     : PREMIUM     bandwidth requested  75% calculated  75%
Profile qosp2     : HIGH        bandwidth requested  10% calculated  13%
Profile qosp1     : NORMAL      bandwidth requested  10% calculated   8%
Profile qosp0     : BEST-EFFORT bandwidth requested   5% calculated   4%
HP9300(config)# write memory
```

Notice that the CLI displays the percentages you request and the percentages the device can provide based on your request. The values are not always the same, as explained below.

Syntax: [no] qos profile <queue> <percentage> <queue> <percentage> <queue> <percentage>
<queue> <percentage>

Each <queue> parameter specifies the name of a queue. You can specify the queues in any order on the command line, but you must specify each queue.

The <percentage> parameter specifies a number for the percentage of the device's outbound bandwidth that are allocating to the queue.

NOTE: The percentages you enter must equal 100. Also, the percentage for the premium queue (the highest priority queue) must be at least 50.

If you enter percentages that are less than the minimum percentages supported for a queue, the CLI recalculates the percentages to fall within the supported minimums. Here is an example. In this example, the values entered for all but the best-effort queue (the lowest priority queue) are much lower than the minimum values supported for those queues.

```
HP9300(config)# qos qosp3 1 qosp2 1 qosp1 2 qosp0 96
Warning - qosp3 bandwidth should be at least 50%
bandwidth scheduling mechanism: weighted priority
Profile qosp3     : PREMIUM     bandwidth requested   1% calculated  50%
Profile qosp2     : HIGH        bandwidth requested   1% calculated  25%
Profile qosp1     : NORMAL      bandwidth requested   2% calculated  13%
Profile qosp0     : BEST-EFFORT bandwidth requested  96% calculated  12%
```

This example shows the warning message that is displayed if you enter a value that is less than 50% for the premium queue. This example also shows the recalculations performed by the CLI. The CLI must normalize the values because the weighted fair queuing algorithm and queue hardware require specific minimum bandwidth allocations. You cannot configure the hardware to exceed the weighted fair queuing limitations.

The CLI normalizes the percentages you enter by increasing the percentages as needed for queues that have less than the minimum percentage, converting the percentages to weights (which the weighted fair queuing algorithm uses), and applying the following equations to calculate the percentages:

$$qosp3 = w3 / (w3 + 1)$$

$$qosp2 = (1 - qosp3) * w2 / (w2 + 1)$$

$$qosp1 = (1 - qosp3 - qosp2) * w1 / (w1 + 1)$$

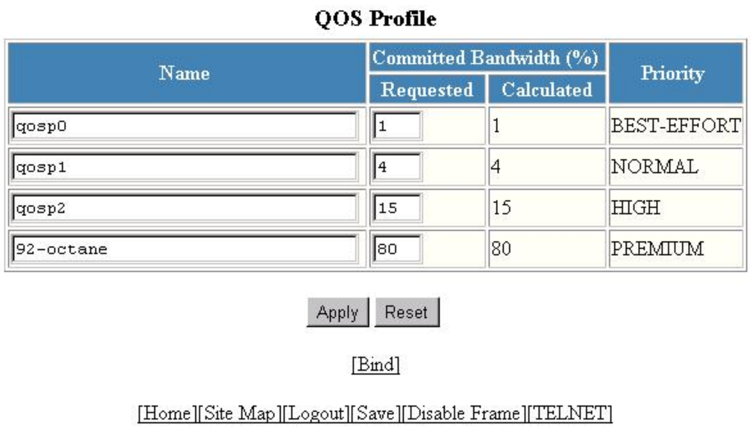
$$qosp0 = 1 - qosp3 - qosp2 - qosp1$$

The value "w" stands for "weight". Thus, these calculations determine the weights that the weighted fair queuing algorithm will use for each queue.

For results that do not differ widely from the percentages you enter, enter successively lower percentages for each queue, beginning with the premium queue. If you enter a higher percentage for a particular queue than you enter for a higher queue, the normalized results can vary widely from the percentages you enter.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to QoS in the tree view to expand the list of QoS option links.
4. Click on the Profile link to display the QoS Profile configuration panel, as shown in the following figure.


QOS Profile

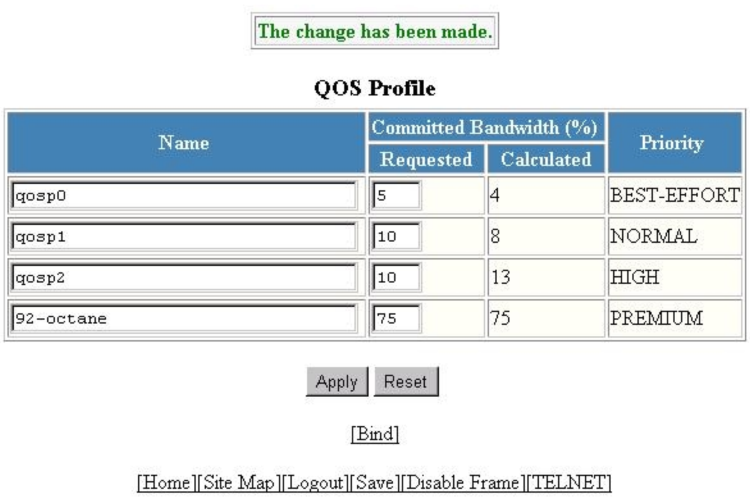
Name	Committed Bandwidth (%)		Priority
	Requested	Calculated	
qosp0	1	1	BEST-EFFORT
qosp1	4	4	NORMAL
qosp2	15	15	HIGH
92-octane	80	80	PREMIUM

5. Edit the values in the Requested fields for the queue(s) you want to change. In this example, the following minimum bandwidths are requested:
   - qosp0 – 5%
   - qosp1 – 10%
   - qosp2 – 10%
   - 92-octane – 75%

NOTE: The percentages you enter must equal 100. Also, the percentage for the premium queue (the highest priority queue) must be at least 50.

---

6. Click the Apply button to save the changes to the device's running-config file. Notice that the device calculates the minimum bandwidth percentages that can be allocated to each of the queues based on your percentage requests, and displays the actual percentages in the Calculated column. Here is an example.


The change has been made.

QOS Profile

Name	Committed Bandwidth (%)		Priority
	Requested	Calculated	
qosp0	5	4	BEST-EFFORT
qosp1	10	8	NORMAL
qosp2	10	13	HIGH
92-octane	75	75	PREMIUM

7. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Resetting the Minimum Bandwidth Percentages to Their Defaults

You can use either of the following CLI commands to reset the QoS queues to their default bandwidth percentages (and therefore to their default weights).

USING THE CLI

Enter either of the following commands at the global CONFIG level:

- **qos mechanism weighted**
- **no qos profile**

USING THE WEB MANAGEMENT INTERFACE

You cannot reset the queue profiles to the default bandwidth percentages using the Web management interface.

Displaying the QoS Profile Configuration

To display the QoS settings, use either of the following methods.

USING THE CLI

To display the QoS settings for all the queues, enter the following command from any level of the CLI:

```
HP9300(config)# show qos-profiles all
bandwidth scheduling mechanism: weighted priority
Profile qosp3     : PREMIUM     bandwidth requested  75% calculated  75%
Profile qosp2     : HIGH        bandwidth requested  10% calculated  13%
Profile qosp1     : NORMAL      bandwidth requested  10% calculated   8%
Profile qosp0     : BEST-EFFORT bandwidth requested   5% calculated   4%
```

Syntax: show qos-profiles all | <name>

The **all** parameter displays the settings for all four queues. The <name> parameter displays the settings for the specified queue.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to QoS in the tree view to expand the list of QoS option links.
4. Click on the Profile link to display the QoS Profile configuration panel.

Assigning QoS Priorities to Traffic

By default, traffic of the following categories is forwarded using the best-effort queue (qosp0):

- Incoming port (sometimes called the ingress port)
- Port-based VLAN membership
- Static destination MAC entry
- Layer 3 and Layer 4 information (IP and TCP/UDP source and destination information)
- AppleTalk socket

NOTE: Tagged VLAN traffic is placed in a queue corresponding to the 802.1p priority in the tag by default. Thus, if a tagged packet contains priority 7 in the tag (corresponding to the premium queue), the device places this packet in the premium queue of the packet's outbound port. You can change or remove the effect of the 802.1p priority in the tags by reassigning the priority levels to different queues. See "Reassigning 802.1p Priorities to Different Queues" on page 2-14.

Although it is possible for a packet to qualify for an adjusted QoS priority based on more than one of the criteria above, the system always gives a packet the highest priority for which it qualifies. Thus, if a packet is entitled to the premium queue because of its IP source and destination addresses, but is entitled only to the high queue because of its incoming port, the system places the packet in the premium queue on the outgoing port.

When you apply a QoS priority to one of the items listed above, you specify a number from 0 – 7. The number specifies the IEEE 802.1 equivalent to one of the four HP QoS queues. The numbers correspond to the queues as follows.

Priority Level	Queue
6, 7	qosp3
4, 5	qosp2
2, 3	qosp1
0, 1	qosp0

The following sections describe how to change the priority for each of the items listed above.

Changing a Port's Priority

To change a port's QoS priority, use one of the following methods. The priority applies to outbound traffic on the port.

USING THE CLI

To change the QoS priority of port 1/1 to the high queue (qosp2), enter the following commands:

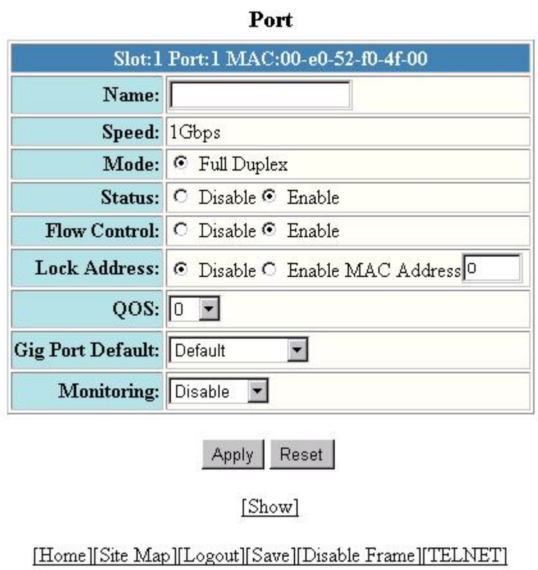
```
HP9300(config)# interface ethernet 1/1
HP9300(config-if-1/1)# priority 5
HP9300(config-if-1/1)# write memory
```

Syntax: [no] priority <num>

The <num> parameter can be from 0 – 7 and specifies the IEEE 802.1 equivalent to one of the four QoS queues.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the Port link to display the Port table.
3. Scroll down to the port for which you want to change the QoS level, then click on the Modify button to the right of the port information to display the Port configuration panel, as shown in the following example.



4. Select a QoS level from 0 – 7 from the QoS field's pulldown menu.
5. Click the Apply button to save the change to the device's running-config file.
6. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Changing a Layer 2 Port-Based VLAN's Priority

By default, VLANs have priority 0 (the best effort queue, qosp0). To change a port-based VLAN's QoS priority, use one of the following methods. The priority applies to outbound traffic on ports in the VLAN.

NOTE: Tagged packets also contain a priority value in the 802.1q tag. If you use the default priority for a VLAN, a tagged packet that exits on that VLAN can be placed into a higher priority queue based on the port priority, the priority in the 802.1q tag, and so on. If you do not want the device to make priority decisions based on 802.1q tags, you can change the priority for 802.1q tags on a VLAN basis. See "Reassigning 802.1p Priorities to Different Queues" on page 2-14".

USING THE CLI

To change the QoS priority of port-based VLAN 20 to the premium queue (qosp3), enter the following commands:

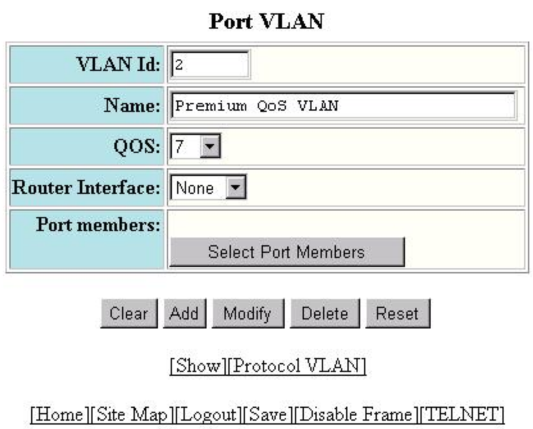
```
HP9300(config)# vlan 20
HP9300(config-vlan-20)# priority 7
HP9300(config-vlan-20)# write memory
```

Syntax: [no] priority <num>

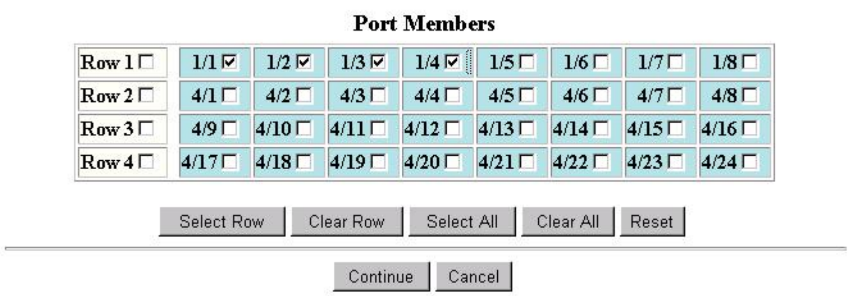
The <num> parameter can be from 0 – 7 and specifies the IEEE 802.1 equivalent to one of the four QoS queues.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to VLAN in the tree view to expand the list of VLAN option links.
4. Click on the Port link to display the Port VLAN panel.
   - If you are adding a new port-based VLAN, click on the Add Port VLAN link to display the Port VLAN configuration panel, as shown in the following example.
   - If you are modifying an existing port-based VLAN, click on the Modify button to the right of the row describing the VLAN to display the Port VLAN configuration panel, as shown in the following example.



5. Select a QoS level from 0 – 7 from the QoS field's pulldown menu.
6. If you are adding a new VLAN, click the Select Port Members button to display the Port Members dialog, as shown in the following example.



7. Select the ports you are placing in the VLAN. To select a row, click on the checkbox next to the row number, then click on the Select Row button.
8. When you finish selecting the ports, click on the Continue button to return to the Port VLAN configuration dialog.
9. Click the Add button (to add a new VLAN) or the Modify button (if you are modifying an existing VLAN) to save the change to the device's running-config file.
10. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Reassigning 802.1p Priorities to Different Queues

Tagged priority applies to tagged packets that come in from tagged ports. These packets have a tag in the header that specifies the packet's VLAN ID and its 802.1p priority tag value, which is 3 bits long.

By default, an HP device interprets the prioritization information in the 3-bit priority tag as follows.

Priority Level	Queue
6, 7	qosp3
4, 5	qosp2
2, 3	qosp1
0, 1	qosp0

This is the HP default interpretation for the eight prioritization values in every context (VLAN, static MAC entry, IP access policy, and so on). If the VLAN for the packet uses the default priority (0, equal to the qosp0 queue), then the HP device uses the priority information in the packet to assign the packet to a queue on its incoming port. However, if the VLAN or the incoming port itself has a higher priority than the packet's 802.1p priority, the HP device uses the VLAN priority or incoming port priority, whichever is higher.

You can specify how the HP device interprets the 3-bit priority information by reassigning the priority levels to other queues. For example, if you want the device to disregard the 802.1p priority and instead assign the priority based on other items (VLAN, port, and so on), configure the device to set all the 802.1p priorities to the best-effort queue (qosp0). If a tagged packet's 802.1p priority level is always in the qosp0 queue, then the packet's outbound queue is affected by other items such as incoming port, VLAN, and so on.

To reassign the priorities to different queues, use either of the following methods.

USING THE CLI

To reassign all 802.1p priority levels 2 – 7 to the best-effort queue (qosp0), enter the following commands:

```
HP9300(config)# qos tagged-priority 2 qosp0
HP9300(config)# qos tagged-priority 3 qosp0
HP9300(config)# qos tagged-priority 4 qosp0
HP9300(config)# qos tagged-priority 5 qosp0
HP9300(config)# qos tagged-priority 6 qosp0
HP9300(config)# qos tagged-priority 7 qosp0
HP9300(config)# write memory
```

Syntax: [no] qos tagged-priority <num> <queue>

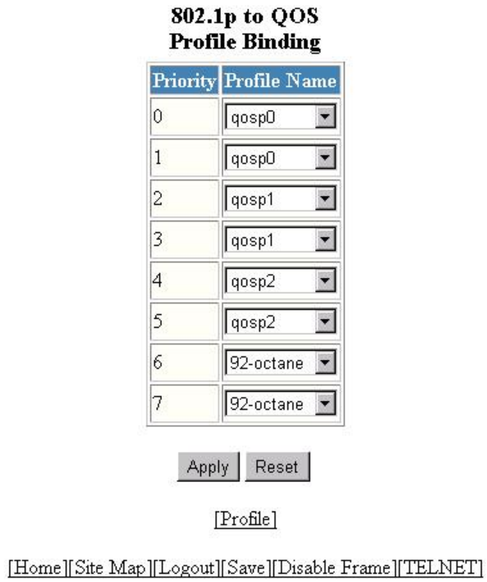
The <num> parameter can be from 0 – 7 and specifies the IEEE 802.1 equivalent to one of the four QoS queues.

The <queue> parameter specifies the queue to which you are reassigning the priority level. You must specify one of the named queues. The default names are qosp3, qosp2, qosp1, and qosp0. The example above reassigns the 802.1p levels to queue qosp0. (There is no need to reassign levels 0 and 1 in this case, because they are already assigned to qosp0 by default.)

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to QoS in the tree view to expand the list of QoS option links.

4. Click on the Bind link to display the QoS 802.1p to QoS Profile Binding configuration panel, as shown in the following figure.



5. For each priority level, select the QoS queue to which you want to reassign the profile by selecting the queue name from the Profile field's pulldown list. For example, to reassign priority 7 to QoS queue qosp0, select qosp0 from the Profile Name field's pulldown list in the row for priority 7.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Displaying the Queue Assignments for the 802.1p Priorities

To display the queues to which the 802.1p priorities are assigned, use either of the following methods.

USING THE CLI

To display the queue assignments for all the priorities, enter the following command at any level of the CLI:

```
HP9300(config)# show priority-mapping all
802.1p priority 0 mapped to qos profile qosp0
802.1p priority 1 mapped to qos profile qosp0
802.1p priority 2 mapped to qos profile qosp1
802.1p priority 3 mapped to qos profile qosp1
802.1p priority 4 mapped to qos profile qosp2
802.1p priority 5 mapped to qos profile qosp2
802.1p priority 6 mapped to qos profile qosp3
802.1p priority 7 mapped to qos profile qosp3
```

In this example, the priorities still have their default queue assignments.

Syntax: show priority-mapping all | <num>

The **all** parameter displays the queue assignments for all the priorities. Alternatively, you can display the assignment for a particular level by specifying the level number, as shown in the following example.

```
HP9300(config)# show priority-mapping 1
802.1p priority 1 mapped to qos profile qosp0
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to QoS in the tree view to expand the list of QoS option links.
4. Click on the Bind link to display the QoS 802.1p to QoS Profile Binding configuration panel. The queue assignments are listed for each of the eight priority levels.

Assigning Static MAC Entries to Priority Queues

By default, all MAC entries are in the best effort queue (qosp0). When you configure a static MAC entry, you can assign the entry to a higher QoS level using either of the following methods.

USING THE CLI

To configure a static MAC entry and assign the entry to the premium queue, enter commands such as the following:

```
HP9300(config)# vlan 9
HP9300(config-vlan-9)# static-mac-address 1145.1163.67FF e12 priority 7
HP9300(config)# write memory
```

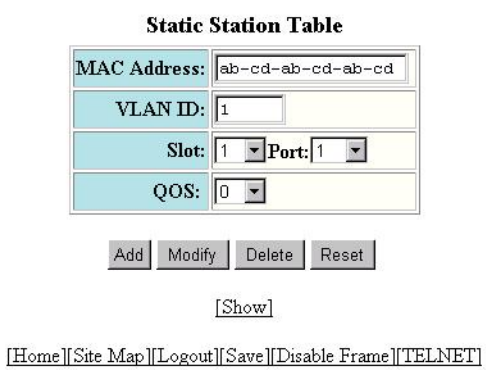
Syntax: [no] static-mac-address <mac-addr> ethernet <portnum> [priority <num>]
[host-type | router-type]

The <num> parameter can be from 0 – 7 and specifies the IEEE 802.1 equivalent to one of the four QoS queues.

NOTE: On a routing switch, the **static-mac-address** command is at the port VLAN configuration level. On an HP 6208M-SX, the **static-mac-address** command is at the global CONFIG level.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Select the Static Station link to display the Static Station Table.
   - If the system already contains static MAC addresses and you are adding a new static MAC address, click on the Add Static Station link to display the Static Station Table configuration panel, as shown in the following example.
   - If you are modifying an existing static MAC address, click on the Modify button to the right of the row describing the static MAC address to display the Static Station Table configuration panel, as shown in the following example.



4. Enter or edit the MAC address, if needed. Specify the address in the following format: xx-xx-xx-xx-xx-xx.
5. Change the VLAN number if needed by editing the value in the VLAN ID field.
6. Select the port number from the Slot (for Chassis devices) and Port pulldown lists.
7. Select a QoS level from 0 – 7 from the QoS field's pulldown menu.
8. Click the Add button (to add a new static MAC entry) or the Modify button (if you are modifying an existing entry) to save the change to the device's running-config file.
9. Click the Apply button to save the change to the device's running-config file.
10. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Assigning IP and Layer 4 Sessions to Priority Queues

You can assign specific traffic flows to queues by configuring IP access policies. IP access policies allow you to assign flows to priority queues based on any combination of the following criteria:

- Source IP address
- Destination IP address
- Layer 4 type (TCP or UDP)
- TCP or UDP port number

You configure IP access policies globally, then apply them to specific ports. QoS policies apply only to outbound traffic, so you must apply the QoS polices to a port's outbound direction instead of the port's inbound direction.

To configure an IP access policy for assigning a traffic flow to a priority queue, use either of the following methods.

USING THE CLI

The CLI syntax differs between routing switches and switches. Examples and syntax are shown for both types of devices.

Routing Switch Syntax

To assign a priority of 4 to all HTTP traffic on port 3/12 on an HP 9304M or HP 9308M routing switch, enter the following:

```
HP9300(config)# ip access-policy 1 priority 4 any any tcp eq http
HP9300(config)# int e 3/12
HP9300(config-if-3/12)# ip access-policy-group out 1
```

Here is the syntax for routing switches.

Syntax: [no] ip access-policy <num> priority <0-7> <ip-addr> <ip-mask> | any <ip-addr> <ip-mask> | any icmp | igmp | igrp | ospf | tcp | udp | <num> [<operator> [<tcp/udp-port-num>]]

Syntax: ip access-policy-group in | out <policy-list>

The <num> parameter is the policy number.

The **priority** <0-7> parameter specifies the QoS priority level. The default is 0 (best effort, qosp0). The highest priority is 7 (premium, qosp3).

The <ip-addr> <ip-mask> **| any** <ip-addr> <ip-mask> **| any** parameters specify the source and destination IP addresses. If you specify a particular IP address, you also need to specify the mask for that address. If you specify **any** to apply the policy to all source or destination addresses, you do not need to specify **any** again for the mask. Make sure you specify a separate address and mask or any for the source and destination address.

The **icmp | igmp | igrp | ospf | tcp | udp |** <num> parameter specifies the Layer 4 port to which you are applying the policy. If you specify **tcp** or **udp**, you also can use the optional <operator> and <tcp/udp-port-num> parameters to fine-tune the policy to apply to specific TCP or UDP ports.

The <operator> parameter applies only if you use the **tcp** or **udp** parameter above. Use the <operator> parameter to specify the comparison condition for the specific TCP or UDP ports. For example, if you are configuring QoS for HTTP, specify **tcp eq http**. You can enter one of the following operators:

- **eq** – The policy applies to the TCP or UDP port name or number you enter after **eq**.
- **gt** – The policy applies to TCP or UDP port numbers greater than the port number or the numeric equivalent of the port name you enter after **gt**.
- **lt** – The policy applies to TCP or UDP port numbers that are less than the port number or the numeric equivalent of the port name you enter after **lt**.
- **neq** – The policy applies to all TCP or UDP port numbers except the port number or port name you enter after **neq**.
- **range** – The policy applies to all TCP or UDP port numbers that are between the first TCP or UDP port name or number and the second one you enter following the range parameter. The range includes the port names or numbers you enter. For example, to apply the policy to all ports between and including 23 (Telnet) and 53 (DNS), enter the following: range 23 53. The first port number in the range must be lower than the last number in the range.
- **established** – This operator applies only to TCP packets. If you use this operator, the QoS policy applies to TCP packets that have the ACK (Acknowledgment) or RST (Reset) bits set on (set to “1”) in the Control Bits field of the TCP packet header. Thus, the policy applies only to established TCP sessions, not to new sessions. See Section 3.1, “Header Format”, in RFC 793 for information about this field.

The **in** parameter applies the policy to packets received in the port.

The **out** parameter applies the policy to packets sent on the port.

NOTE: To apply the policy to traffic in both directions, enter two **ip access-policy-group** commands, one specifying the **in** parameter, and the other specifying the **out** parameter.

The <policy-list> parameter is a list of policy IDs.

NOTE: The device applies the policies in the order you list them, so make sure you order them in such a away that you receive the results you expect. Once a packet matches a policy, the device takes the action specified in that policy and stops comparing the packet to the policies in the list.

Figure 2.2 and Figure 2.3 show the CLI syntax for configuring a Layer 4 QoS policy on an HP routing switch.

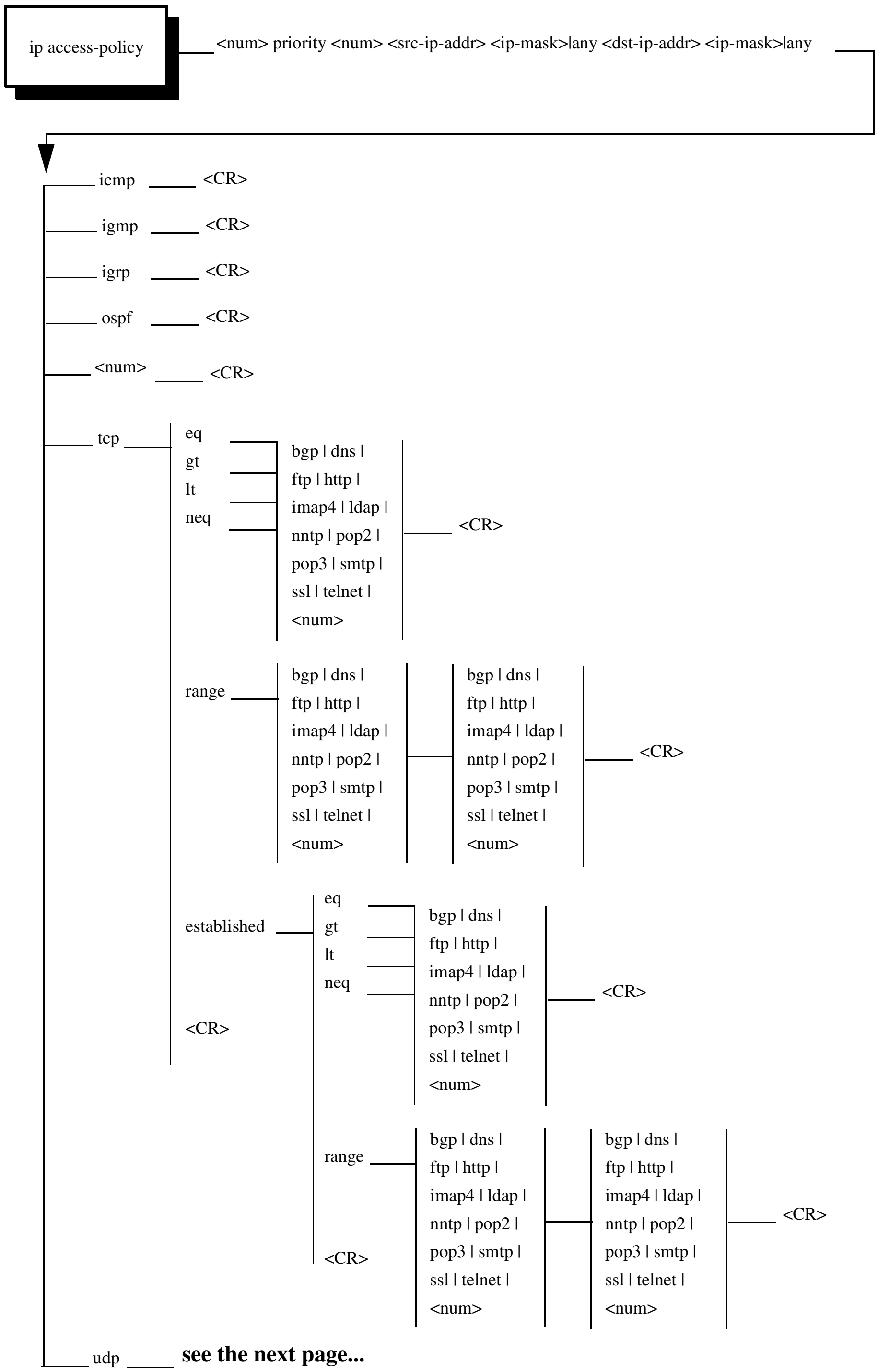


Figure 2.2 QoS IP policy syntax for an HP routing switch (1 of 2)

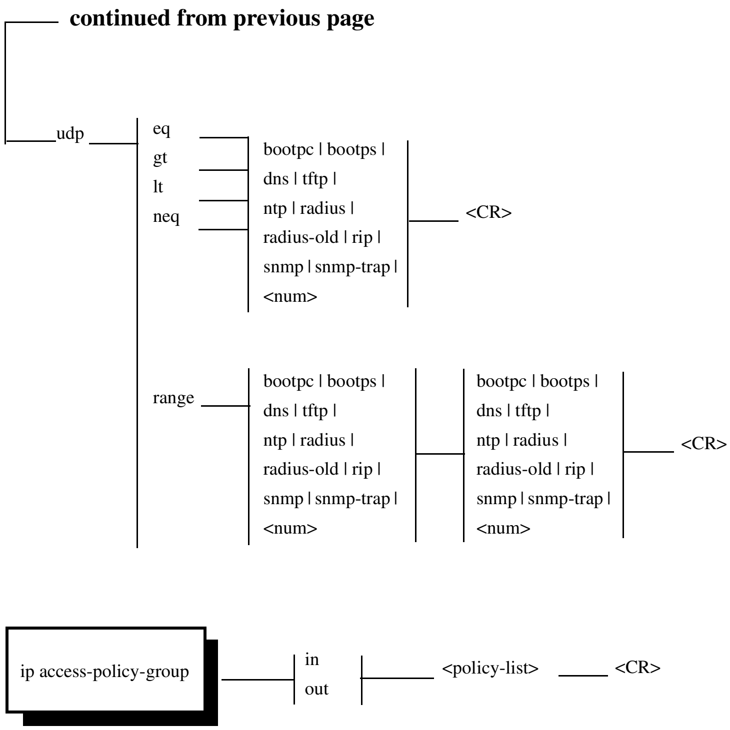


Figure 2.3 QoS IP policy syntax for an HP routing switch (2 of 2)

Switch Syntax

To assign a priority of 7 to FTP traffic on all ports on an HP 6208M-SX switch, enter the following commands:

```
HP6208(config)# ip policy 1 7 tcp ftp global
HP6208(config)# write memory
```

To assign a priority of 7 to HTTP traffic on ports 1 and 2 only, enter the following commands:

```
HP6208(config)# ip policy 2 7 tcp http local
HP6208(config)# int ethernet 1
HP6208(config-if-1)# ip-policy 2
HP6208(config-if-1)# int ethernet 2
HP6208(config-if-2)# ip-policy 2
HP6208(config)# write memory
```

Syntax: policy <num> priority <0-7> tcp | udp <tcp/udp-port-num> global | local

[no] ip-policy <num>

The <num> parameter is the policy number.

The **priority** <0-7> parameter specifies the QoS priority level. The default is 0 (best effort queue, qosp0). The highest priority is 7 (premium, qosp3).

The **tcp | udp** <tcp/udp-port-num> parameter specifies the TCP or UDP port to which you are applying the policy.

The **global** and **local** parameters specify the scope of the policy:

- If you specify **global**, the policy applies to all ports.
- If you specify **local**, the policy will apply to the ports you specify. Use the following command on the Interface level of the CLI to apply the policy to a port: **ip-policy** <num>

Figure 2.4 shows the CLI syntax for configuring a QoS policy on an HP switch. The value “<CR>” means “carriage return”, also known as the Enter key.

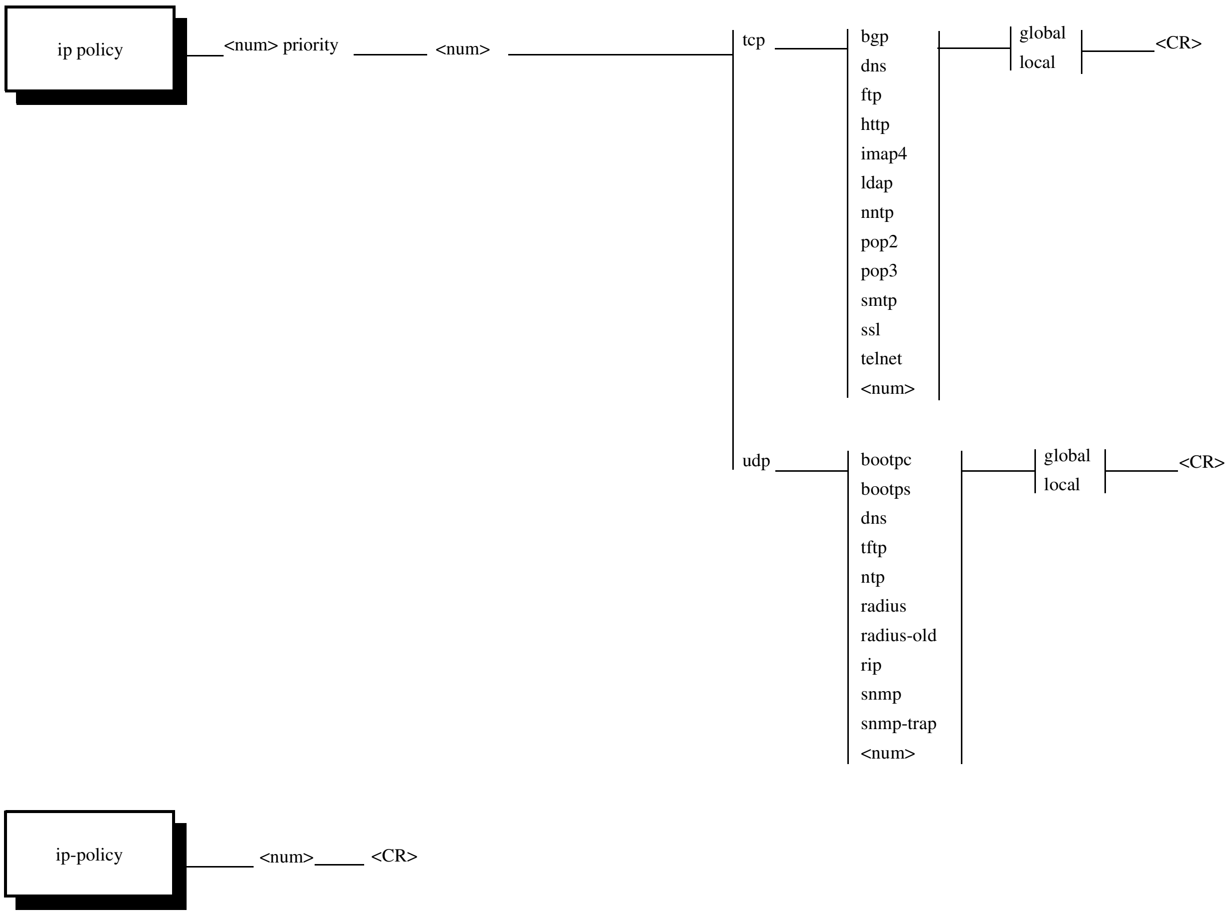


Figure 2.4 QoS IP policy syntax for an HP switch

NOTE: The **ip policy** command allows you to configure global or local QoS policies. Use the **ip-policy** command (note the difference between “**ip policy**” and “**ip-policy**”) at the Interface level of the CLI to apply a local policy to a specific interface.

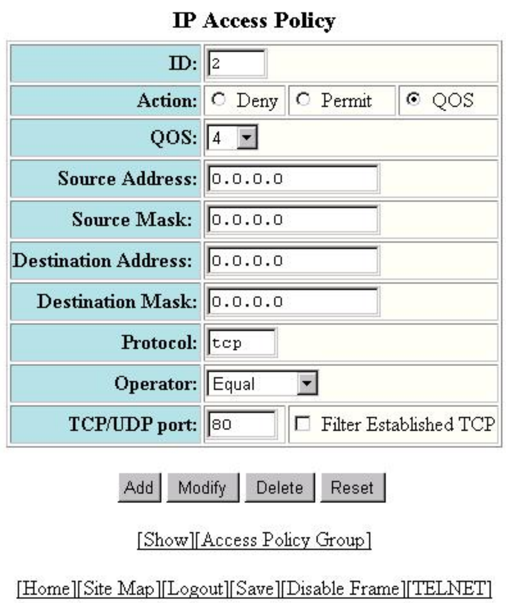
USING THE WEB MANAGEMENT INTERFACE

The Web management options for assigning QoS priorities to traffic flows differ between routing switches and switches. Examples are shown for both types of devices.

Routing Switch

To assign a priority of 4 to all HTTP traffic on port 3/12 on an HP 9304M or HP 9308M routing switch, perform the following steps:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the Access Policy link to display the IP Access Policy panel.
    - If the system already contains IP access policies and you are adding a new one, click on the Add IP Access Policy link to display the IP Access Policy configuration panel, as shown in the following example.
    - If you are modifying an existing IP access policy, click on the Modify button to the right of the row describing the IP access policy to display the IP Access Policy configuration panel, as shown in the following example.



5. Enter the ID for the policy in the ID field.
6. Select the QoS radio button next to Action.
7. Select a QoS level from 0 – 7 from the QoS field's pulldown menu. In this example, select 4.
8. Enter the source IP address and network mask in the Source Address and Source Mask fields. To specify "any" for a field, leave all four zeros in the field. In this example, leave the zeros.
9. Enter the destination IP address and network mask in the Destination Address and Destination Mask fields. To specify "any" for a field, leave all four zeroes in the field. In this example, leave the zeros.
10. If you want the policy to apply only to packets containing specific types of Layer 4 traffic, enter the protocol in the Protocol field. You can enter the protocol's Layer 4 port number or one of the following well-known names:
    - icmp
    - igmp
    - igrp

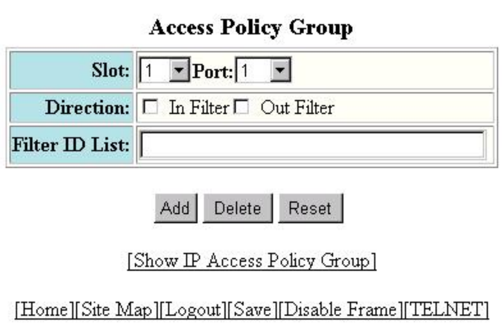
- ospf
- tcp
- udp

In this example, enter tcp.

11. If you entered tcp or udp, you also can select one of the following comparison operators from the Operator field.
    - Equal – The policy applies to the TCP or UDP port name or number you enter in the TCP/UDP port field. In this example, select Equal.
    - Greater – The policy applies to TCP or UDP port numbers greater than the port number or the numeric equivalent of the port name you enter in the TCP/UDP port field.
    - Less – The policy applies to TCP or UDP port numbers that are less than the port number or the numeric equivalent of the port name you enter in the TCP/UDP port field.
    - Not Equal – The policy applies to all TCP or UDP port numbers except the port number or port name you enter in the TCP/UDP port field.
12. If you entered tcp or udp in the Protocol field, enter the TCP or UDP port number in the TCP/UDP port field. In this example, enter 80 (the well-known port for HTTP).
13. If you entered tcp in the Protocol field and you want the policy to apply to TCP sessions that are already in effect, click on the checkbox next to Established. If you select this option, the QoS policy applies to TCP packets that have the ACK (Acknowledgment) or RST (Reset) bits set on (set to "1") in the Control Bits field of the TCP packet header. Thus, the policy applies only to established TCP sessions, not to new sessions. See Section 3.1, "Header Format", in RFC 793 for information about this field.

NOTE: This option applies only to destination TCP ports, not to source TCP ports.

14. Click the Add button (to add a new policy) or the Modify button (if you are modifying an existing policy) to save the policy to the device's running-config file.
15. Select the Access Policy Group link to display the Access Policy Group panel.
    - If the system already contains IP access policy groups and you are adding a new one, click on the Add IP Access Policy Group link to display the IP Access Policy Group configuration panel, as shown in the following example.
    - If you are modifying an existing IP access policy, click on the Modify button to the right of the row describing the IP access policy group to display the IP Access Policy Group configuration panel, as shown in the following example.



16. Select the port number from the Slot (for Chassis devices) and Port pulldown lists. In this example, select 3/12.

17. Click the checkbox next to In Filter, Out Filter, or next to both options to indicate the traffic direction to which you are applying the policy.
    - The In Filter option applies the policy to packets received in the port.
    - The Out Filter option applies the policy to packets sent on the port.
    - If you select both, the policy applies to traffic in both directions.

    In this example, select Out Filter.
18. Enter the policy IDs in the Filter ID List field.

NOTE: The device applies the policies in the order you list them, so make sure you order them in such a way that you receive the results you expect. Once a packet matches a policy, the device takes the action specified in that policy and stops comparing the packet to the policies in the list.

---

19. Click the Add button to apply the change to the device's running-config file.
20. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

NOTE: You also can access the dialog for saving configuration changes by clicking on Command in the tree view, then clicking on Save to Flash.

Switch

To assign a priority of 7 to FTP traffic on all ports on an HP 6208M-SX switch, perform the following steps:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Select the Layer 4 QoS link to display the QoS panel.
3. Enter the ID for the policy in the ID field.
4. Select the Switch or Port radio button next to Scope to indicate whether the policy applies globally or only to certain ports.
5. Select a QoS level from 0 – 7 from the QoS field's pulldown menu. In this example, select 7.
6. Select the UDP or TCP radio button next to Protocol to specify the type of traffic to which the QoS policy applies.
7. Select a well-known TCP or UDP port name (depending on whether you selected TCP or UDP) from the TCP/UDP Port field's pulldown list. To enter a port number instead, click on the User Define button to change the field into an entry field, then enter the port number. For this example, select FTP.
8. Click the Add button to apply the change to the device's running-config file.
9. If you selected Port in step 4, click on Port QoS to display the Port QoS panel. Otherwise, go to step 13.
10. Select the port number from the Slot (for Chassis devices) and Port pulldown lists.
11. Enter the policy IDs in the QoS ID List field.

NOTE: The device applies the policies in the order you list them, so make sure you order them in such a away that you receive the results you expect. Once a packet matches a policy, the device takes the action specified in that policy and stops comparing the packet to the policies in the list.

---

12. Click the Add button to apply the change to the device's running-config file.
13. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Assigning AppleTalk Sockets to Priority Queues

By default, all AppleTalk sockets are in the best effort queue (qosp0). To assign an AppleTalk socket to a higher priority queue, use either of the following methods.

USING THE CLI

To assign socket 123 to the premium queue, enter the following commands:

```
HP9300(config)# appletalk qos socket 123 priority 7
HP9300(config)# write memory
```

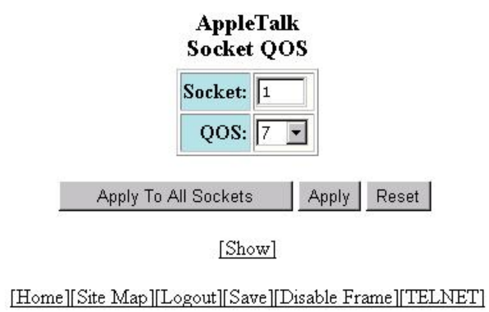
Syntax: [no] appletalk qos socket <num> priority <num>

The first <num> parameter specifies the socket number.

The second <num> parameter can be from 0 – 7 and specifies the IEEE 802.1 equivalent to one of the four QoS queues.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. If AppleTalk is not already enabled, enable it by selecting the Enable radio button next to AppleTalk, then clicking Apply.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to AppleTalk in the tree view to expand the list of AppleTalk option links.
5. Click on the Socket QoS link to display the AppleTalk Socket QoS panel, as shown in the following example.



6. Edit the socket number in the Socket field if needed.
7. Select a QoS level from 0 – 7 from the QoS field's pulldown menu.
8. Click on the Apply button to apply the new QoS setting to the socket number specified in the Socket field or click on the Apply To All Sockets button to apply the new QoS setting to all AppleTalk sockets.
9. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring a Utilization List for an Uplink Port

You can configure uplink utilization lists that display the percentage of a given uplink port's bandwidth that is used by a specific list of downlink ports. The percentages are based on 30-second intervals of RMON packet statistics for the ports. Both transmit and receive traffic is counted in each percentage.

NOTE: This feature is intended for ISP or collocation environments in which downlink ports are dedicated to various customers' traffic and are isolated from one another. If traffic regularly passes between the downlink ports, the information displayed by the utilization lists does not provide a clear depiction of traffic exchanged by the downlink ports and the uplink port.

Each uplink utilization list consists of the following:

- Utilization list number (1, 2, 3, or 4)
- One or more uplink ports
- One or more downlink ports

Each list displays the uplink port and the percentage of that port's bandwidth that was utilized by the downlink ports over the most recent 30-second interval.

You can configure up to four bandwidth utilization lists. To do so, use either of the following methods.

USING THE CLI

To configure an uplink utilization list, enter commands such as the following. The commands in this example configure a link utilization list with port 1/1 as the uplink port and ports 1/2 and 1/3 as the downlink ports.

```
HP9300(config)# relative-utilization 1 uplink eth 1/1 downlink eth 1/2 to 1/3
HP9300(config)# write memory
```

Syntax: [no] relative-utilization <num> uplink ethernet <portnum> [to <portnum> | <portnum>…]
downlink ethernet <portnum> [to <portnum> | <portnum>…]

The <num> parameter specifies the list number. You can configure up to four lists. Specify a number from 1 – 4.

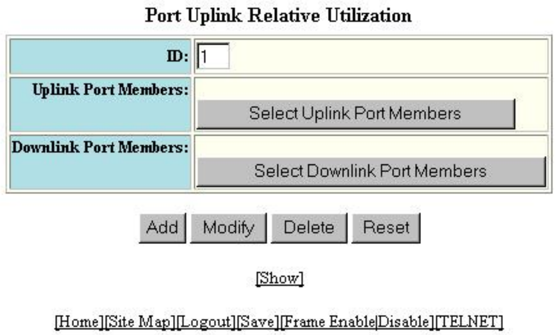
The **uplink ethernet** parameters and the port number(s) you specify after the parameters indicate the uplink port(s).

The **downlink ethernet** parameters and the port number(s) you specify after the parameters indicate the downlink port(s).

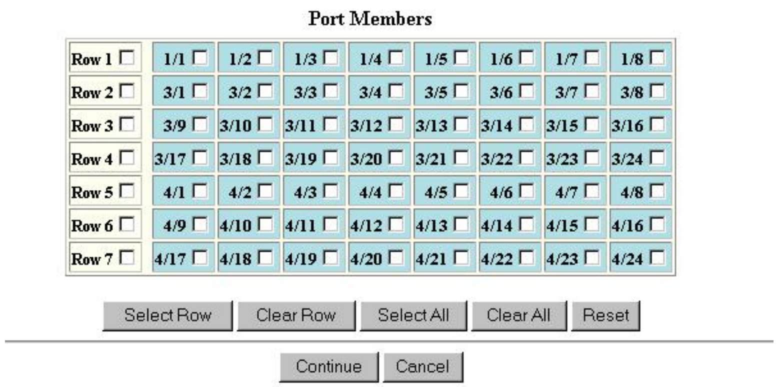
USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the Port link to display the Port Configuration panel.

4. Click on the Relative Utilization link at the top of the panel to display the Port Uplink Relative Utilization panel, as shown in the following example:



5. Enter the ID for the link utilization list in the ID field. You can specify a number from 1 – 4.
6. Click the Select Uplink Port Members button. A Port Members panel similar to the following is displayed.



7. Select the boxes next to the ports you want to include in the uplink list. When you have finished, click Continue.
8. On the Port Uplink Relative Utilization panel, click the Select Downlink Port Members button to display a Port Members panel for downlink ports.
9. Select the boxes next to the ports you want to include in the downlink list. When you have finished, click Continue.
10. On the Port Uplink Relative Utilization panel, click the Add button create the uplink utilization list.
11. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Displaying Utilization Percentages for an Uplink

After you configure an uplink utilization list, you can display the list to observe the percentage of the uplink's bandwidth that each of the downlink ports used during the most recent 30-second port statistics interval. The number of packets sent and received between the two ports is listed, as well as the ratio of each individual downlink port's packets relative to the total number of packets on the uplink.

To display uplink utilization percentages, use either of the following methods.

USING THE CLI

To display an uplink utilization list, enter a command such as the following at any level of the CLI:

```
HP9300(config)# show relative-utilization 1
uplink: ethe 1
30-sec total uplink packet count = 3011
packet count ratio (%)
  1/ 2:60   1/ 3:40
```

In this example, ports 1/2 and 1/3 are sending traffic to port 1/1. Port 1/2 and port 1/3 are isolated (not shared by multiple clients) and typically do not exchange traffic with other ports except for the uplink port, 1/1.

Syntax: show relative-utilization <num>

The <num> parameter specifies the list number.

NOTE: The example above represents a pure configuration in which traffic is exchanged only by ports 1/2 and 1/1, and by ports 1/3 and 1/1. For this reason, the percentages for the two downlink ports equal 100%. In some cases, the percentages do not always equal 100%. This is true in cases where the ports exchange some traffic with other ports in the system or when the downlink ports are configured together in a port-based VLAN.

In the following example, ports 1/2 and 1/3 are in the same port-based VLAN.

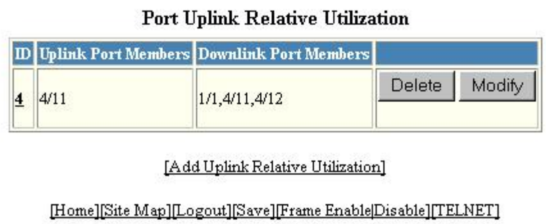
```
HP9300(config)# show relative-utilization 1
uplink: ethe 1
30-sec total uplink packet count = 3011
packet count ratio (%)
  1/ 2:100   1/ 3:100
```

Here is another example showing different data for the same link utilization list. In this example, port 1/2 is connected to a hub and is sending traffic to port 1/1. Port 1/3 is unconnected.

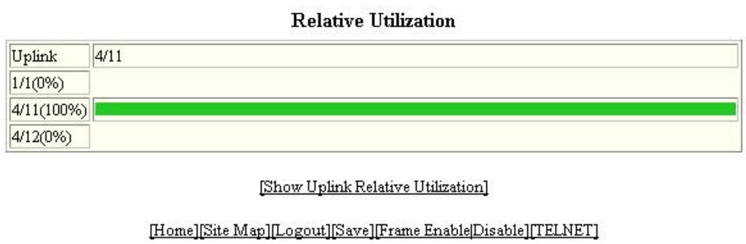
```
HP9300(config)# show relative-utilization 1
uplink: ethe 1
30-sec total uplink packet count = 2996
packet count ratio (%)
  1 /2:100   1/ 3:---
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the Port link to display the Port Configuration panel.
4. Click on the Relative Utilization link at the top of the panel to display the Port Uplink Relative Utilization panel.
5. Click on the Show link. A panel listing the configured uplink utilization lists is displayed:



6. Click on the ID of an uplink utilization list to display utilization percentages for the ports in the list.



This panel displays a graph of the percentage of the uplink's bandwidth that each of the downlink ports used during the most recent 30-second port statistics interval.

Chapter 3
Using Access Control Lists (ACLs)

Access control lists (ACLs) enable you to permit or deny packets based on source and destination IP address, IP protocol information, or TCP or UDP protocol information. You can configure the following types of ACLs:

- Standard – Permits or denies packets based on source IP address. Valid standard ACL IDs are 1 – 99 or a string.
- Extended – Permits or denies packets based on source and destination IP address and also based on IP protocol information. Valid extended ACL IDs are a number from 100 – 199 or a string.

This chapter also describes Policy-Based Routing (PBR), a feature that allows you to use ACLs and route maps to selectively modify and route IP packets based on their source IP address.

NOTE: This chapter describes IP forwarding ACLs and management access ACLs only. For information about ACLs used for BGP4 filtering, see “Configuring BGP4” on page 10-1.

NOTE: For optimal performance, apply deny ACLs to inbound ports instead of outbound ports. This way, traffic is dropped as it tries to enter the HP device, instead of being dropped after it has been forwarded internally to the outbound port.

NOTE: Outbound ACLs do not filter broadcast traffic or any traffic (including ICMP replies) generated by the HP device itself.

Overview

The following section describes ACLs. To configure ACLs, go to the following sections:

Usage Guidelines for Access Control Lists (ACLs)

This section provides some guidelines for implementing ACLs to ensure wire-speed ACL performance.

For optimal ACL performance, use the following guidelines:

- Apply ACLs to inbound traffic rather than outbound traffic.
- Use the default filtering behavior as much as possible. For example, if you are concerned with filtering only a few specific addresses, create deny entries for those addresses, then create a single entry to permit all other traffic. For tighter control, create explicit permit entries and use the default deny action for all other addresses.
- Use deny ACLs sparingly. When a deny ACL is applied to an interface, the software sends all packets sent or received on the interface (depending on the traffic direction of the ACL) to the CPU for examination.
- Adjust system resources if needed:
  - If IP traffic is going to be high, increase the size of the IP forwarding cache to allow more routes. To do so, use the **system-max ip-cache** <num> command at the global CONFIG level of the CLI.
  - If much of the IP traffic you are filtering is UDP traffic, increase the size of the session table to allow more ACL sessions. To do so, use the **system-max session-limit** <num> command at the global CONFIG level of the CLI.

Avoid the following implementations when possible:

- Do not apply ACLs to outbound traffic. The system creates separate inbound ACLs to ensure that an outbound ACL is honored for traffic that normally would be forwarded to other ports.
- Do not enable the strict TCP ACL mode unless you need it for tighter security.
- Avoid ICMP-based ACLs where possible. If you are interested in providing protection against ICMP Denial of Service (DoS) attacks, use HP's DoS protection features. See "Protecting Against Denial of Service Attacks" on page B-1.

If the IP traffic in your network is characterized by a high volume of short sessions, this also can affect ACL performance, since this traffic initially must go to the CPU. All ICMP ACLs go to the CPU, as do all TCP SYN, SYN/ACK, FIN, and RST packets and the first UDP packet of a session.

ACL Support on the HP Products

HP ACLs have two basic types of uses:

- Filtering forwarded traffic through the device – described in this chapter
- Controlling management access to the device itself – described in the "Securing Access" chapter in the *Installation and Getting Started Guide*

ACL IDs and Entries

ACLs consist of ACL IDs and ACL entries:

- ACL ID – An ACL ID is a number from 1 – 99 (for a standard ACL) or 100 – 199 (for an extended ACL) or a character string. The ACL ID identifies a collection of individual ACL entries. When you apply ACL entries to an interface, you do so by applying the ACL ID that contains the ACL entries to the interface, instead of applying the individual entries to the interface. This makes applying large groups of access filters (ACL entries) to interfaces simple.

NOTE: This is different from IP access policies. If you use IP access policies, you apply the individual policies to interfaces.

- ACL entry – An ACL entry is a filter command associated with an ACL ID. The maximum number of ACL entries you can configure is a system-wide parameter and depends on the device you are configuring. You can configure up to the maximum number of entries in any combination in different ACLs. The total number of entries in all ACLs cannot exceed the system maximum.

NOTE: Up to 1024 entries are supported on routing switches.

You configure ACLs on a global basis, then apply them to the incoming or outgoing traffic on specific ports. You can apply only one ACL to a port's inbound traffic and only one ACL to a port's outbound traffic. The software applies the entries within an ACL in the order they appear in the ACL's configuration. As soon as a match is found, the software takes the action specified in the ACL entry (permit or deny the packet) and stops further comparison for that packet.

Default ACL Action

The default action when no ACLs are configured on a device is to permit all traffic. However, once you configure an ACL and apply it to a port, the default action for that port is to deny all traffic that is not explicitly permitted on the port.

- If you want to tightly control access, configure ACLs consisting of permit entries for the access you want to permit. The ACLs implicitly deny all other access.
- If you want to secure access in environments with many users, you might want to configure ACLs that consist of explicit deny entries, then add an entry to permit all access to the end of each ACL. The software permits packets that are not denied by the deny entries.

NOTE: The software generates log entries only when packets are explicitly denied by ACLs. The software does not generate log entries for explicitly permitted entries or for entries that are implicitly denied.

NOTE: Do not apply an empty ACL (an ACL ID without any corresponding entries) to an interface. If you accidentally do this, the software applies the default ACL action, deny all, to the interface and thus denies all traffic.

Controlling Management Access to the Device

You can use standard ACLs to control Telnet, Web, and SNMP access to a device. See the "Securing Access" chapter in the *Installation and Getting Started Guide*.

ACL Logging

ACL logging is disabled by default. However, when you configure an ACL entry, you can enable logging for that entry by adding the **log** parameter to the end of the CLI command for the entry.

When you enable logging for an ACL entry, statistics for packets that match the deny conditions of the ACL entry are logged. For example, if you configure a standard ACL entry to deny all packets from source address 209.157.22.26, statistics for packets that are explicitly denied by the ACL entry are logged in the HP device's Syslog buffer and in SNMP traps sent by the device.

The first time an ACL entry denies a packet, the software immediately generates a Syslog entry and SNMP trap. The software also starts a five-minute timer. The timer keeps track of all packets explicitly denied by the ACL entries. After five minutes, the software generates a single Syslog entry for each ACL entry that has denied a packet. The message indicates the number of packets denied by the ACL entry during the previous five minutes.

If no ACL entries explicitly deny packets during an entire five-minute timer interval, the timer stops. The timer restarts when an ACL entry explicitly denies a packet.

NOTE: The timer for logging packets denied by Layer 2 filters is separate.

The following sections describe how to configure standard and extended ACLs.

NOTE: The following sections describe how to configure ACLs using the HP device's CLI. You also can create and modify ACLs using a text editor on a file server, then copy them to the device's running-config file. In fact, this method is a convenient way to reorder individual ACL entries within an ACL. See "Modifying ACLs" on page 3-19.

Disabling or Re-Enabling Access Control Lists (ACLs)

A routing switch cannot actively use both IP access policies and ACLs for filtering IP traffic. When you boot a routing switch with software release 06.6.x or higher, the software checks the device's startup-config file for **ip access-policy-group** commands, which associate IP access policies with ports. If the software finds an **ip access-policy-group** command in the file, the software disables all packet-forwarding ACLs (those associated with specific ports) and also prevents you from applying an ACL to a port.

The next time you save the startup-config file, the software adds the following command near the top of the file, underneath the **ver** (software version) statement:

ip dont-use-acl

This command disables all packet-forwarding ACLs (those associated with specific ports) and also prevents you from associating an ACL with a port. However, the command does not remove existing ACLs from the startup-config file. In addition, the command does not affect ACLs used for controlling management access to the device.

Enabling ACL Mode

If you try to apply an ACL to a port when the ACL mode is disabled (when the **ip dont-use-acl** command is in effect), a message is displayed, as shown in the following CLI example:

```
HP9300(config-if-e1000-1/1)# ip access-group 1 out
Must enable ACL mode first by using no ip dont-use-acl command and removing all ip
access-policy-group commands from interfaces, write memory and reload
```

As the message states, if you want to use ACLs, you must first enable the ACL mode. To do so, use either of the following methods.

USING THE CLI

To enable the ACL mode, enter the following commands:

```
HP9300(config-if-e1000-1/1)# exit
HP9300(config)# no ip dont-use-acl
HP9300(config)# write memory
HP9300(config)# end
HP9300# reload
```

The **write memory** command removes the **ip dont-use-acl** command from the startup-config file. The **reload** command reloads the software. When the software finishes loading, you can apply ACLs to ports.

The commands that configure the IP access policies and apply them to ports remain in the startup-config file in case you want to use them again, but they are disabled. If you later decide you want to use the IP access policies again instead of ACLs, you must disable the ACL mode again. See the following section.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Select the Enable radio button next to Access Control List.
6. Click the Apply button to save the change to the device's running-config file.

7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Disabling ACL Mode

If the ACL mode is enabled, a message is displayed when you try to apply an IP access policy to a port, as shown in the following CLI example:

```
HP9300(config-if-e1000-1/1)# ip access-policy-group 1 in
Must disable ACL mode first by using ip dont-use-acl command, write memory and
reload
```

To use the IP access policies, you first must disable the ACL mode using either of the following methods.

USING THE CLI

To disable the ACL mode, enter the following commands:

```
HP9300(config-if-e1000-1/1)# exit
HP9300(config)# ip dont-use-acl
HP9300(config)# write memory
HP9300(config)# end
HP9300# reload
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Select the Disable radio button next to Access Control List.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring Standard ACLs

This section describes how to configure standard ACLs with numeric IDs.

- For configuration information on named ACLs, see "Configuring Named ACLs" on page 3-18.
- For configuration information on extended ACLs, see "Configuring Extended ACLs" on page 3-9.

Standard ACLs permit or deny packets based on source IP address. You can configure up to 99 standard ACLs. You can configure up to 1024 individual ACL entries on a device. There is no limit to the number of ACL entries an ACL can contain except for the system-wide limitation of 1024 total ACL entries.

USING THE CLI

To configure a standard ACL and apply it to outgoing traffic on port 1/1, enter the following commands.

```
HP9300(config)# access-list 1 deny host 209.157.22.26 log
HP9300(config)# access-list 1 deny 209.157.29.12 log
HP9300(config)# access-list 1 deny host IPHost1 log
HP9300(config)# access-list 1 permit any
HP9300(config)# int eth 1/1
HP9300(config-if-1/1)# ip access-group 1 out
HP9300(config)# write memory
```

The commands in this example configure an ACL to deny packets from three source IP addresses from being forwarded on port 1/1. The last ACL entry in this ACL permits all packets that are not explicitly denied by the first three ACL entries.

Standard ACL Syntax

Syntax: [no] access-list <num> deny | permit <source-ip> | <hostname> <wildcard> [log]

or

Syntax: [no] access-list <num> deny | permit <source-ip>/<mask-bits> | <hostname> [log]

Syntax: [no] access-list <num> deny | permit host <source-ip> | <hostname> [log]

Syntax: [no] access-list <num> deny | permit any [log]

Syntax: [no] ip access-group <num> in | out

The <num> parameter is the access list number and can be from 1 – 99.

The **deny | permit** parameter indicates whether packets that match a policy in the access list are denied (dropped) or permitted (forwarded).

The <source-ip> parameter specifies the source IP address. Alternatively, you can specify the host name.

NOTE: To specify the host name instead of the IP address, the host name must be configured using the HP device’s DNS resolver. To configure the DNS resolver name, use the **ip dns server-address…** command at the global CONFIG level of the CLI.

The <wildcard> parameter specifies the mask value to compare against the host address specified by the <source-ip> parameter. The <wildcard> is a four-part value in dotted-decimal notation (IP address format) consisting of ones and zeros. Zeros in the mask mean the packet’s source address must match the <source-ip>. Ones mean any value matches. For example, the <source-ip> and <wildcard> values 209.157.22.26 0.0.0.255 mean that all hosts in the Class C sub-net 209.157.22.x match the policy.

If you prefer to specify the wildcard (mask value) in CIDR format, you can enter a forward slash after the IP address, then enter the number of significant bits in the mask. For example, you can enter the CIDR equivalent of “209.157.22.26 0.0.0.255” as “209.157.22.26/24”. The CLI automatically converts the CIDR number into the appropriate ACL mask (where zeros instead of ones are the significant bits) and changes the non-significant portion of the IP address into ones. For example, if you specify 209.157.22.26/24 or 209.157.22.26 0.0.0.255, then save the changes to the startup-config file, the value appears as 209.157.22.0/24 (if you have enabled display of sub-net lengths) or 209.157.22.0 0.0.0.255 in the startup-config file.

If you enable the software to display IP sub-net masks in CIDR format, the mask is saved in the file in “/<mask-bits>” format. To enable the software to display the CIDR masks, enter the **ip show-subnet-length** command at the global CONFIG level of the CLI. You can use the CIDR format to configure the ACL entry regardless of whether the software is configured to display the masks in CIDR format.

NOTE: If you use the CIDR format, the ACL entries appear in this format in the running-config and startup-config files, but are shown with sub-net mask in the display produced by the
show access-list and **show ip access-list** commands.

The **host** <source-ip> | <hostname> parameter lets you specify a host IP address or name. When you use this parameter, you do not need to specify the mask. A mask of all zeros (0.0.0.0) is implied.

The **any** parameter configures the policy to match on all host addresses.

The **log** argument configures the device to generate Syslog entries and SNMP traps for packets that are denied by the access policy.

NOTE: You can enable logging on ACLs and filters that support logging even when the ACLs and filters are already in use. To do so, re-enter the ACL or filter command and add the **log** parameter to the end of the ACL or filter. The software replaces the ACL or filter command with the new one. The new ACL or filter, with logging enabled, takes effect immediately.

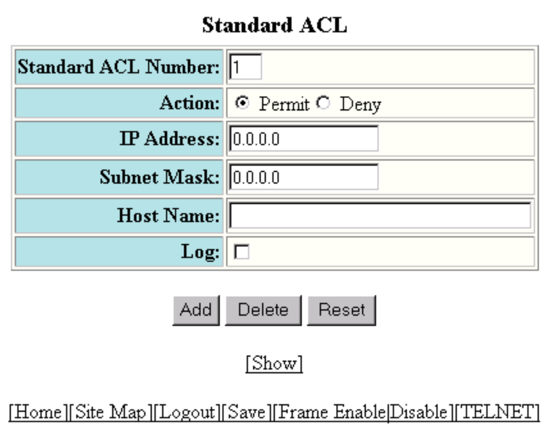
The **in | out** parameter specifies whether the ACL applies to incoming traffic or outgoing traffic on the interface to which you apply the ACL. You can apply the ACL to an Ethernet port or virtual interface.

NOTE: If the ACL is for the inbound traffic direction on a virtual routing interface, you also can specify a subset of ports within the VLAN containing that interface when assigning an ACL to the interface. See “Configuring Named ACLs” on page 3-18.

USING THE WEB MANAGEMENT INTERFACE

To configure a standard ACL:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to display the list of configuration options.
3. Click on the plus sign next to System or IP to display more configuration options. You can access the ACL configuration panels from either location.
4. Select the Standard ACL link.
   - If the device does not already have some standard ACLs, the Standard ACL configuration panel is displayed, as shown in the following example.
   - Otherwise, if the device already has some standard ACLs, the Standard ACL table is displayed. This table lists the configured ACLs. Select the Add Standard ACL link to display the Standard ACL configuration panel, as shown in the following example.



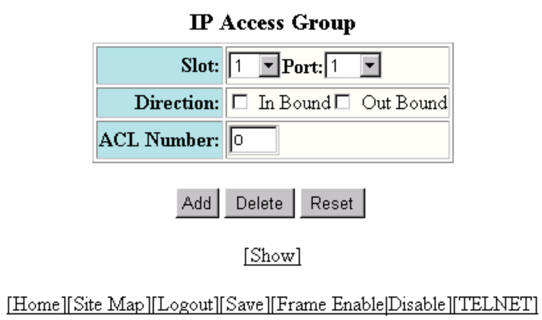
5. Change the ACL number in the Standard ACL Number field or use the ACL number displayed in the field.

   NOTE: You cannot specify a name.

6. Select the ACL action. You can select Permit or Deny:
   - Permit – Forwards traffic or allows management access for the specified IP source.
   - Deny – Drops traffic or denies management access for the specified IP source.

NOTE: If the ACL is a forwarding ACL, the action forwards or drops the traffic. If the ACL is a management access ACL, the action permits or denies management access.

7. Enter the source information. You can enter the source IP address and network mask or the host name.
   - If you enter the address, you also must enter the network mask. To specify "any", enter "0.0.0.0".
   - If you enter a host name instead of an IP address, when you click Add to add the ACL, the Web management interface sends a DNS query for the address. For the query to be successful, the device must have network access to a DNS server and the server must have an Address record for the host. In addition, the device must be configured with a DNS domain name and the IP address of the DNS server.
8. If you specified the Deny action, optionally enable logging by selecting the Log checkbox. If you enable logging for this ACL entry, the software generates Syslog entries for traffic that the ACL denies.
9. Select the IP Access Group link from the tree view.
   - If the device does not already have some ACLs applied to interfaces, the IP Access Group configuration panel is displayed, as shown in the following example.
   - Otherwise, if the device already has some ACLs applied to interfaces, the IP Access Group table is displayed. Select the Add link to display the IP Access Group configuration panel, as shown in the following example.



10. Select the Slot (if you are configuring a Chassis device) and port from the Slot and Port pulldown menus.
11. Specify the traffic direction to which the ACL applies. You can select one or both of the following:
    - In Bound – The ACL applies to traffic received on the port from other devices.
    - Out Bound – The ACL applies to traffic this HP device queues for transmission on the port.
12. Enter the ACL number in the ACL Number field.

NOTE: You cannot specify a named ACL.

13. Click the Add button to save the ACL and the association of the ACL with an interface to the device's running-config file.
14. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

NOTE: You also can access the dialog for saving configuration changes by clicking on Command in the tree view, then clicking on Save to Flash.

Configuring Extended ACLs

This section describes how to configure extended ACLs.

- For configuration information on named ACLs, see “Configuring Named ACLs” on page 3-18.
- For configuration information on standard ACLs, see “Configuring Standard ACLs” on page 3-5.

Extended ACLs let you permit or deny packets based on the following information:

- IP protocol
- Source IP address or host name
- Destination IP address or host name
- Source TCP or UDP port (if the IP protocol is TCP or UDP)
- Destination TCP or UDP port (if the IP protocol is TCP or UDP)

The IP protocol can be one of the following well-known names or any IP protocol number from 0 – 255:

- Internet Control Message Protocol (ICMP)
- Internet Group Management Protocol (IGMP)
- Internet Gateway Routing Protocol (IGRP)
- Internet Protocol (IP)
- Open Shortest Path First (OSPF)
- Transmission Control Protocol (TCP)
- User Datagram Protocol (UDP)

For TCP and UDP, you also can specify a comparison operator and port name or number. For example, you can configure a policy to block web access to a specific website by denying all TCP port 80 (HTTP) packets from a specified source IP address to the website’s IP address.

USING THE CLI

To configure an extended access list that blocks all Telnet traffic received on port 1/1 from IP host 209.157.22.26, enter the following commands.

```
HP9300(config)# access-list 101 deny tcp host 209.157.22.26 any eq telnet log
HP9300(config)# access-list 101 permit ip any any
HP9300(config)# int eth 1/1
HP9300(config-if-1/1)# ip access-group 101 in
HP9300(config)# write memory
```

Here is another example of commands for configuring an extended ACL and applying it to an interface. These examples show many of the syntax choices. Notice that some of the entries are configured to generate log entries while other entries are not thus configured.

```
HP9300(config)# access-list 102 perm icmp 209.157.22.0/24 209.157.21.0/24
HP9300(config)# access-list 102 deny igmp host rkwong 209.157.21.0/24 log
HP9300(config)# access-list 102 deny igrp 209.157.21.0/24 host rkwong log
HP9300(config)# access-list 102 deny ip host 209.157.21.100 host 209.157.22.1 log
HP9300(config)# access-list 102 deny ospf any any log
HP9300(config)# access-list 102 permit ip any any
```

The first entry permits ICMP traffic from hosts in the 209.157.22.*x* network to hosts in the 209.157.21.*x* network.

The second entry denies IGMP traffic from the host device named “rkwong” to the 209.157.21.*x* network.

The third entry denies IGRP traffic from the 209.157.21.*x* network to the host device named “rkwong”.

The fourth entry denies all IP traffic from host 209.157.21.100to host 209.157.22.1 and generates Syslog entries for packets that are denied by this entry.

The fifth entry denies all OSPF traffic and generates Syslog entries for denied traffic.

The sixth entry permits all packets that are not explicitly denied by the other entries. Without this entry, the ACL would deny all incoming or outgoing IP traffic on the ports to which you assign the ACL.

The following commands apply ACL 102 to the incoming and outgoing traffic on port 1/2 and to the incoming traffic on port 4/3.

```
HP9300(config)# int eth 1/2
HP9300(config-if-1/2)# ip access-group 102 in
HP9300(config-if-1/2)# ip access-group 102 out
HP9300(config-if-1/2)# exit
HP9300(config)# int eth 4/3
HP9300(config-if-4/3)# ip access-group 102 in
HP9300(config)# write memory
```

Here is another example of an extended ACL.

```
HP9300(config)# access-list 103 deny tcp 209.157.21.0/24 209.157.22.0/24
HP9300(config)# access-list 103 deny tcp 209.157.21.0/24 eq ftp 209.157.22.0/24
HP9300(config)# access-list 103 deny tcp 209.157.21.0/24 209.157.22.0/24 lt telnet
neq 5
HP9300(config)# access-list 103 deny udp any range 5 6 209.157.22.0/24 range 7 8
HP9300(config)# access-list 103 permit any any
```

The first entry in this ACL denies TCP traffic from the 209.157.21.*x* network to the 209.157.22.x network.

The second entry denies all FTP traffic from the 209.157.21.*x* network to the 209.157.22.x network.

The third entry denies TCP traffic from the 209.157.21.*x* network to the 209.157.22.*x* network, if the TCP port number of the traffic is less than the well-known TCP port number for Telnet (23), and if the TCP port is not equal to 5. Thus, TCP packets whose TCP port numbers are 5 or are greater than 23 are allowed.

The fourth entry denies UDP packets from any source to the 209.157.22.*x* network, if the UDP port number from the source network is 5 or 6 and the destination UDP port is 7 or 8.

The fifth entry permits all packets that are not explicitly denied by the other entries. Without this entry, the ACL would deny all incoming or outgoing IP traffic on the ports to which you assign the ACL.

The following commands apply ACL 103 to the incoming and outgoing traffic on ports 2/1 and 2/2.

```
HP9300(config)# int eth 2/1
HP9300(config-if-2/1)# ip access-group 103 in
HP9300(config-if-2/1)# ip access-group 103 out
HP9300(config-if-2/1)# exit
HP9300(config)# int eth 2/2
HP9300(config-if-2/2)# ip access-group 103 in
HP9300(config-if-2/2)# ip access-group 103 out
HP9300(config)# write memory
```

Filtering on IP Precedence and TOS Values

To configure an extended IP ACL that matches based on IP precedence, enter commands such as the following:

```
HP9300(config)# access-list 103 deny tcp 209.157.21.0/24 209.157.22.0/24 precedence
internet
HP9300(config)# access-list 103 deny tcp 209.157.21.0/24 eq ftp 209.157.22.0/24
precedence 6
HP9300(config)# access-list 103 permit any any
```

The first entry in this ACL denies TCP traffic from the 209.157.21.*x* network to the 209.157.22.x network, if the traffic has the IP precedence option “internet” (equivalent to “6”).

The second entry denies all FTP traffic from the 209.157.21.*x* network to the 209.157.22.x network, if the traffic has the IP precedence value “6” (equivalent to “internet”).

The third entry permits all packets that are not explicitly denied by the other entries. Without this entry, the ACL would deny all incoming or outgoing IP traffic on the ports to which you assign the ACL.

To configure an IP ACL that matches based on TOS, enter commands such as the following:

```
HP9300(config)# access-list 104 deny tcp 209.157.21.0/24 209.157.22.0/24 tos normal
HP9300(config)# access-list 104 deny tcp 209.157.21.0/24 eq ftp 209.157.22.0/24 tos
13
HP9300(config)# access-list 104 permit any any
```

The first entry in this IP ACL denies TCP traffic from the 209.157.21.*x* network to the 209.157.22.x network, if the traffic has the IP TOS option “normal” (equivalent to “0”).

The second entry denies all FTP traffic from the 209.157.21.*x* network to the 209.157.22.x network, if the traffic has the IP precedence value “13” (equivalent to “max-throughput”, “min-delay”, and “min-monetary-cost”).

The third entry permits all packets that are not explicitly denied by the other entries. Without this entry, the ACL would deny all incoming or outgoing IP traffic on the ports to which you assign the ACL.

Extended ACL Syntax

Syntax: access-list <num> deny | permit <ip-protocol> <source-ip> | <hostname> <wildcard> [<operator> <source-tcp/udp-port>] <destination-ip> | <hostname> <wildcard> [<operator> <destination-tcp/udp-port>] [precedence <name> | <num>] [tos <name> | <num>] [log]

Syntax: [no] access-list <num> deny | permit host <ip-protocol> any any [log]

Syntax: [no] ip access-group <num> in | out

The <num> parameter indicates the ACL number and be from 100 – 199 for an extended ACL.

The **deny | permit** parameter indicates whether packets that match the policy are dropped or forwarded.

The <ip-protocol> parameter indicates the type of IP packet you are filtering. You can specify one of the following:

- **icmp**
- **igmp**
- **igrp**
- **ip**
- **ospf**
- **tcp**
- **udp**
- <protocol-number>

The <source-ip> | <hostname> parameter specifies the source IP host for the policy. If you want the policy to match on all source addresses, enter **any**.

The <wildcard> parameter specifies the portion of the source IP host address to match against. The <wildcard> is a four-part value in dotted-decimal notation (IP address format) consisting of ones and zeros. Zeros in the mask mean the packet’s source address must match the <source-ip>. Ones mean any value matches. For example, the <source-ip> and <wildcard> values 209.157.22.26 0.0.0.255 mean that all hosts in the Class C sub-net 209.157.22.x match the policy.

If you prefer to specify the wildcard (mask value) in Classless Interdomain Routing (CIDR) format, you can enter a forward slash after the IP address, then enter the number of significant bits in the mask. For example, you can enter the CIDR equivalent of “209.157.22.26 0.0.0.255” as “209.157.22.26/24”. The CLI automatically converts the CIDR number into the appropriate ACL mask (where zeros instead of ones are the significant bits) and changes the non-significant portion of the IP address into zeros. For example, if you specify 209.157.22.26/24 or

209.157.22.26 0.0.0.255, then save the changes to the startup-config file, the value appears as 209.157.22.0/24 (if you have enabled display of sub-net lengths) or 209.157.22.0 0.0.0.255 in the startup-config file.

If you enable the software to display IP sub-net masks in CIDR format, the mask is saved in the file in "/<mask-bits>" format. To enable the software to display the CIDR masks, enter the **ip show-subnet-length** command at the global CONFIG level of the CLI. You can use the CIDR format to configure the ACL entry regardless of whether the software is configured to display the masks in CIDR format.

NOTE: If you use the CIDR format, the ACL entries appear in this format in the running-config and startup-config files, but are shown with sub-net mask in the display produced by the **show access-list** and **show ip access-list** commands.

The <destination-ip> | <hostname> parameter specifies the destination IP host for the policy. If you want the policy to match on all destination addresses, enter **any**.

The <operator> parameter specifies a comparison operator for the TCP or UDP port number. This parameter applies only when you specify **tcp** or **udp** as the IP protocol. For example, if you are configuring an entry for HTTP, specify **tcp eq http**. You can enter one of the following operators:

- **eq** – The policy applies to the TCP or UDP port name or number you enter after **eq**.
- **gt** – The policy applies to TCP or UDP port numbers greater than the port number or the numeric equivalent of the port name you enter after **gt**.
- **lt** – The policy applies to TCP or UDP port numbers that are less than the port number or the numeric equivalent of the port name you enter after **lt**.
- **neq** – The policy applies to all TCP or UDP port numbers except the port number or port name you enter after **neq**.
- **range** – The policy applies to all TCP or UDP port numbers that are between the first TCP or UDP port name or number and the second one you enter following the **range** parameter. The range includes the port names or numbers you enter. For example, to apply the policy to all ports between and including 23 (Telnet) and 53 (DNS), enter the following: **range 23 53**. The first port number in the range must be lower than the last number in the range.
- **established** – This operator applies only to TCP packets. If you use this operator, the policy applies to TCP packets that have the ACK (Acknowledgment) or RST (Reset) bits set on (set to "1") in the Control Bits field of the TCP packet header. Thus, the policy applies only to established TCP sessions, not to new sessions. See Section 3.1, "Header Format", in RFC 793 for information about this field.

  NOTE: This operator applies only to destination TCP ports, not source TCP ports.

The <tcp/udp-port> parameter specifies the TCP or UDP port number or well-known name. The device recognizes the following well-known names. For other ports, you must specify the port number.

NOTE: The following lists are organized alphabetically. In the CLI, these port names are listed according to ascending port number.

- TCP port names recognized by the software:
  - bgp
  - dns
  - ftp
  - http
  - imap4
  - ldap
  - nntp

    - pop2
    - pop3
    - smtp
    - ssl
    - telnet
- UDP port names recognized by the software:
    - bootps
    - bootpc
    - dns
    - ntp
    - radius
    - radius-old
    - rip
    - snmp
    - snmp-trap
    - tftp

The **in | out** parameter specifies whether the ACL applies to incoming traffic or outgoing traffic on the interface to which you apply the ACL. You can apply the ACL to an Ethernet port or virtual interface.

NOTE: If the ACL is for the inbound traffic direction on a virtual routing interface, you also can specify a subset of ports within the VLAN containing that interface when assigning an ACL to the interface. See "Configuring Named ACLs" on page 3-18.

The **precedence** <name> | <num> parameter of the **ip access-list** command specifies the IP precedence. The precedence option for of an IP packet is set in a three-bit field following the four-bit header-length field of the packet's header. You can specify one of the following:

- **critical** or **5** – The ACL matches packets that have the critical precedence. If you specify the option number instead of the name, specify number 5.
- **flash** or **3** – The ACL matches packets that have the flash precedence. If you specify the option number instead of the name, specify number 3.
- **flash-override** or **4** – The ACL matches packets that have the flash override precedence. If you specify the option number instead of the name, specify number 4.
- **immediate** or **2** – The ACL matches packets that have the immediate precedence. If you specify the option number instead of the name, specify number 2.
- **internet** or **6** – The ACL matches packets that have the internetwork control precedence. If you specify the option number instead of the name, specify number 6.
- **network** or **7** – The ACL matches packets that have the network control precedence. If you specify the option number instead of the name, specify number 7.
- **priority** or **1** – The ACL matches packets that have the priority precedence. If you specify the option number instead of the name, specify number 1.
- **routine** or **0** – The ACL matches packets that have the routine precedence. If you specify the option number instead of the name, specify number 0.

The **tos** <name> | <num> parameter of the **ip access-list** command specifies the IP TOS.

You can specify one of the following:

- **max-reliability** or **2** – The ACL matches packets that have the maximum reliability TOS. The decimal value for this option is 2.
- **max-throughput** or **4** – The ACL matches packets that have the maximum throughput TOS. The decimal value for this option is 4.
- **min-delay** or **8** – The ACL matches packets that have the minimum delay TOS. The decimal value for this option is 8.
- **min-monetary-cost** or **1** – The ACL matches packets that have the minimum monetary cost TOS. The decimal value for this option is 1.
- **normal** or **0** – The ACL matches packets that have the normal TOS. The decimal value for this option is 0.
- <num> – A number from 0 – 15 that is the sum of the numeric values of the options you want. The TOS field is a four-bit field following the Precedence field in the IP header. You can specify one or more of the following. To select more than one option, enter the decimal value that is equivalent to the sum of the numeric values of all the TOS options you want to select. For example, to select the max-reliability and min-delay options, enter number 10. To select all options, select 15.

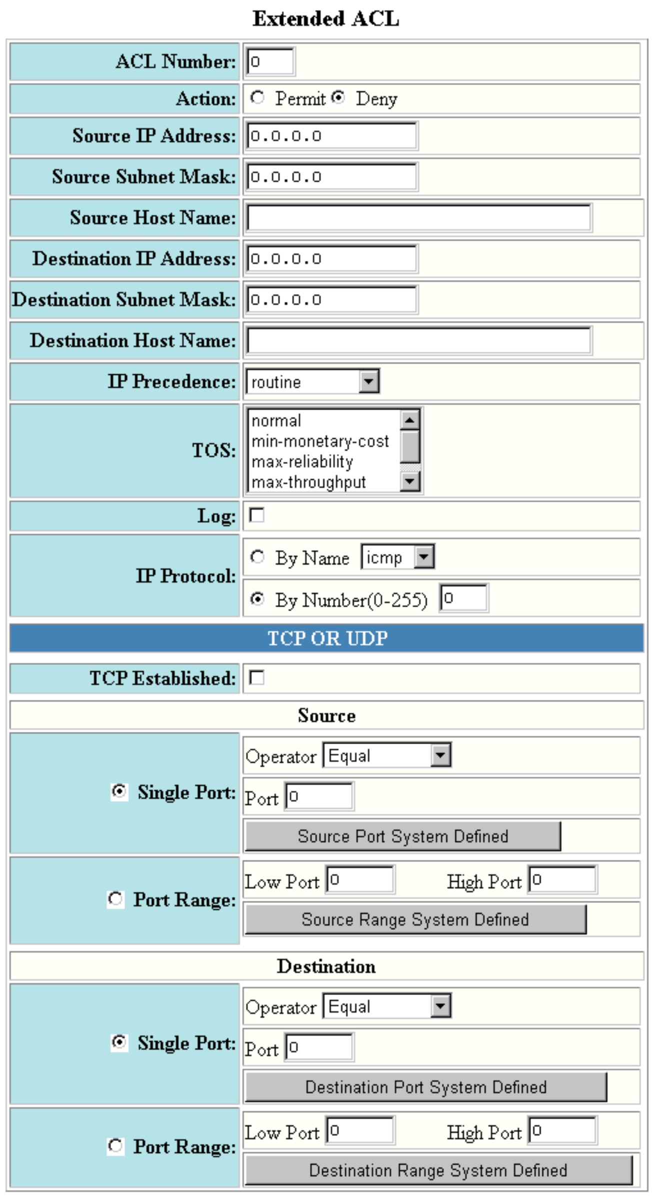
The **log** parameter enables SNMP traps and Syslog messages for packets denied by the ACL.

NOTE: You can enable logging on ACLs and filters that support logging even when the ACLs and filters are already in use. To do so, re-enter the ACL or filter command and add the **log** parameter to the end of the ACL or filter. The software replaces the ACL or filter command with the new one. The new ACL or filter, with logging enabled, takes effect immediately.

USING THE WEB MANAGEMENT INTERFACE

To configure an extended ACL:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to display the list of configuration options.
3. Click on the plus sign next to System or IP to display more configuration options. You can access the ACL configuration panels from either location.
4. Select the Extended ACL link.
   - If the device does not already have some extended ACLs, the Extended ACL configuration panel is displayed, as shown in the following example.
   - Otherwise, if the device already has some extended ACLs, the Extended ACL table is displayed. This table lists the configured ACLs. Select the Add Extended ACL link to display the Extended ACL configuration panel, as shown in the following example.



5. Change the ACL number in the ACL Number field or use the ACL number displayed in the field.

NOTE: You cannot specify a name.

6. Select the ACL action. You can select Permit or Deny:
   - Permit – Forwards traffic that matches the ACL.
   - Deny – Drops traffic that matches the ACL.
7. Enter the source IP information. You can enter the source IP address and network mask or the host name.
   - If you enter the address, you also must enter the network mask. To specify “all”, enter “0.0.0.0”.
   - If you enter a host name instead of an IP address, when you click Add to add the ACL, the Web management interface sends a DNS query for the address. For the query to be successful, the device

must have network access to a DNS server and the server must have an Address record for the host. In addition, the device must be configured with a DNS domain name and the IP address of the DNS server.

8. Enter the destination IP information. The options and requirements are the same as those for entering the source IP information.
9. Select the IP precedence from the IP Precedence pulldown menu (optional). The precedence option for of an IP packet is set in a three-bit field following the four-bit header-length field of the packet's header. You can select one of the following:
   - routine – The ACL matches packets that have the routine precedence.
   - priority – The ACL matches packets that have the priority precedence.
   - immediate – The ACL matches packets that have the immediate precedence.
   - flash – The ACL matches packets that have the flash precedence.
   - flash-override – The ACL matches packets that have the flash override precedence.
   - critical – The ACL matches packets that have the critical precedence.
   - internet – The ACL matches packets that have the internetwork control precedence.
   - network – The ACL matches packets that have the network control precedence.
   - none – The ACL does not use the IP precedence as part of the comparison when filtering.
10. Select the Type of Service (TOS) from the TOS menu (optional). You can select one or more of the following:
    - normal – The ACL matches packets that have the normal TOS.
    - min-monetary-cost or – The ACL matches packets that have the minimum monetary cost TOS.
    - max-reliability – The ACL matches packets that have the maximum reliability TOS.
    - max-throughput – The ACL matches packets that have the maximum throughput TOS.
    - min-delay – The ACL matches packets that have the minimum delay TOS.

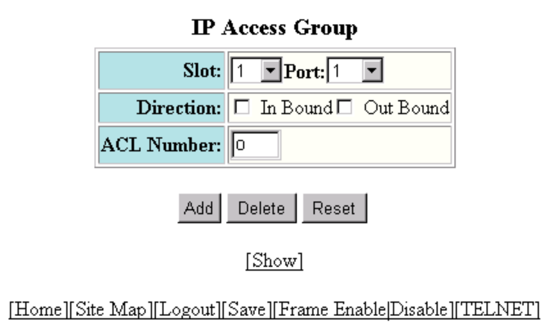
NOTE: To select more than one TOS option, hold the CTRL key while selecting each option.

11. If you specified the Deny action, optionally enable logging by selecting the Log checkbox. If you enable logging for this ACL entry, the software generates Syslog entries for traffic that the ACL denies.
12. Specify the IP protocol. You can specify the protocol by name or by number.
    - To specify the IP protocol by name, select the By Name radio button, then select the protocol from the pulldown menu. You can select one of the following: icmp, igmp, igrp, ip, ospf, tcp, udp.
    - To specify the IP protocol by number, select the By Number radio button, then enter the decimal number of the protocol.
13. If you specified "tcp" or "udp" for the IP protocol, use the following steps to configure the source and destination TCP or UDP options. Otherwise, go to Step 18.
14. Select the Established checkbox if you selected the TCP protocol and you want the ACL to apply to established TCP sessions after you apply the ACL to an interface. Specifically, if you select this option, the ACL applies to TCP packets that have the ACK (Acknowledgment) or RST (Reset) bits set on (set to "1") in the Control Bits field of the TCP packet header. If you do not select this option, the ACL applies only to sessions that begin after you apply the ACL to an interface.
15. Select the comparison operator for the source TCP or UDP port. You can select one of the following:
    - Equal – The ACL applies to the TCP or UDP port you specify in the next step.
    - NotEqual – The ACL applies to all TCP or UDP ports ***except*** the port you specify in the next step.
    - LessThan – The ACL applies to TCP or UDP ports whose numbers are less than the number of the port you specify in the following step.

- GreaterThan – The ACL applies to TCP or UDP ports whose numbers are greater than the number of the port you specify in the following step.

NOTE: The comparison operators apply only when you are filtering on individual source and destination TCP or UDP ports. If you are filtering on a range of ports, the operators do not apply. Instead, the ACL matches on any TCP or UDP port that is equal to a port within the specified range.

16. Specify the source TCP or UDP port. You can specify a single port or a range of ports.
    - To specify a single port, select the radio button next to Single Port. Enter the port number in the Port field. Alternatively, you can select a well-known port name. To do so, select the Source Port System Defined button to change the port number entry field into a pulldown menu containing well-known port names. Select the port from the pulldown menu.
    - To specify a port range, select the radio button next to Port Range. Enter the low port number in the range in the Low Port field and the high port number in the HighPort field. Alternatively, select the Source Range System Defined button to change the entry fields into pulldown menus containing well-known names. Even if you specify the ports by name, you still must select the lower-numbered port first, then select the higher-numbered port.
17. Specify the destination TCP or UDP port. You can specify a single port or a range of ports. The procedures and requirements are the same as those for selecting the source TCP or UDP port. See the previous step.
18. Select the IP Access Group link from the tree view.
    - If the device does not already have some ACLs applied to interfaces, the IP Access Group configuration panel is displayed, as shown in the following example.
    - Otherwise, if the device already has some ACLs applied to interfaces, the IP Access Group table is displayed. Select the Add link to display the IP Access Group configuration panel, as shown in the following example.



19. Select the Slot (if you are configuring a Chassis device) and port from the Slot and Port pulldown menus.
20. Specify the traffic direction to which the ACL applies. You can select one or both of the following:
    - In Bound – The ACL applies to traffic received on the port from other devices.
    - Out Bound – The ACL applies to traffic this HP device queues for transmission on the port.
21. Enter the ACL number in the ACL Number field.

NOTE: You cannot specify a named ACL.

22. Click the Add button to save the ACL and the association of the ACL with an interface to the device's running-config file.
23. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

NOTE: You also can access the dialog for saving configuration changes by clicking on Command in the tree view, then clicking on Save to Flash.

Configuring Named ACLs

When you configure an IP ACL, you can refer to the ACL by a numeric ID or by a name.

- If you refer to the ACL by a numeric ID, you can use 1 – 99 for a standard ACL or 100 – 199 for an extended ACL.
- If you refer to the ACL by a name, you specify whether the ACL is a standard ACL or an extended ACL, then specify the name.

You can configure up to 100 named standard IP ACLs and 100 named extended IP ACLs. You also can configure up to 100 standard ACLs and 100 extended ACLs by number. Regardless of how many ACLs you have, the device can have a maximum of 1024 ACL entries, associated with the ACLs in any combination. (On HP 9304M or HP 9308M Chassis devices with Management II modules, the maximum is 2048.)

To configure a named IP ACL, use the following CLI method.

USING THE CLI

The commands for configuring named ACL entries are different from the commands for configuring numbered ACL entries. The command to configure a numbered ACL is **access-list**. The command for configuring a named ACL is **ip access-list**. In addition, when you configure a numbered ACL entry, you specify all the command parameters on the same command. When you configure a named ACL, you specify the ACL type (standard or extended) and the ACL number with one command, which places you in the configuration level for that ACL. Once you enter the configuration level for the ACL, the command syntax is the same as the syntax for numbered ACLs.

The following examples show how to configure a named standard ACL entry and a named extended ACL entry.

Configuration Example for Standard ACL

To configure a named standard ACL entry, enter commands such as the following.

```
HP9300(config)# ip access-list standard Net1
HP9300(config-std-nacl)# deny host 209.157.22.26 log
HP9300(config-std-nacl)# deny 209.157.29.12 log
HP9300(config-std-nacl)# deny host IPHost1 log
HP9300(config-std-nacl)# permit any
HP9300(config-std-nacl)# exit
HP9300(config)# int eth 1/1
HP9300(config-if-1/1)# ip access-group Net1 out
```

The commands in this example configure a standard ACL named “Net1”. The entries in this ACL deny packets from three source IP addresses from being forwarded on port 1/1. Since the implicit action for an ACL is “deny”, the last ACL entry in this ACL permits all packets that are not explicitly denied by the first three ACL entries. For an example of how to configure the same entries in a numbered ACL, see “Configuring Standard ACLs” on page 3-5.

Notice that the command prompt changes after you enter the ACL type and name. The “std” in the command prompt indicates that you are configuring entries for a standard ACL. For an extended ACL, this part of the command prompt is “ext“. The “nacl” indicates that are configuring a named ACL.

Syntax: ip access-list extended | standard <string> | <num>

The **extended | standard** parameter indicates the ACL type.

The <string> parameter is the ACL name. You can specify a string of up to 256 alphanumeric characters. You can use blanks in the ACL name if you enclose the name in quotation marks (for example, “ACL for Net1”). The <num> parameter allows you to specify an ACL number if you prefer. If you specify a number, you can specify from 1 – 99 for standard ACLs or 100 – 199 for extended ACLs.

NOTE: For convenience, the software allows you to configure numbered ACLs using the syntax for named ACLs. The software also still supports the older syntax for numbered ACLs. Although the software allows both methods for configuring numbered ACLs, numbered ACLs are always formatted in the startup-config and running-config files in using the older syntax, as follows.

```
access-list 1 deny host 209.157.22.26 log
access-list 1 deny 209.157.22.0 0.0.0.255 log
access-list 1 permit any
access-list 101 deny tcp any any eq http log
```

The options at the ACL configuration level and the syntax for the **ip access-group** command are the same for numbered and named ACLs and are described in “Configuring Standard ACLs” on page 3-5.

Configuration Example for Extended ACL

To configure a named extended ACL entry, enter commands such as the following.

```
HP9300(config)# ip access-list extended “block Telnet”
HP9300(config-ext-nacl)# deny tcp host 209.157.22.26 any eq telnet log
HP9300(config-ext-nacl)# permit ip any any
HP9300(config-ext-nacl)# exit
HP9300(config)# int eth 1/1
HP9300(config-if-1/1)# ip access-group “block Telnet” in
```

The options at the ACL configuration level and the syntax for the **ip access-group** command are the same for numbered and named ACLs and are described in “Configuring Extended ACLs” on page 3-9.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure IP ACLs using the Web management interface.

Modifying ACLs

NOTE: This section applies to standard ACLs and to extended ACLs.

When you use the HP device’s CLI or Web management interface to configure an ACL, the software places the ACL entries in the ACL in the order you enter them. For example, if you enter the following entries in the order shown below, the software always applies the entries to traffic in the same order.

```
HP9300(config)# access-list 1 deny 209.157.22.0/24
HP9300(config)# access-list 1 permit 209.157.22.26
```

Thus, if a packet matches the first ACL entry in this ACL and is therefore denied, the software does not compare the packet to the remaining ACL entries. In this example, packets from host 209.157.22.26 will always be dropped, even though packets from this host match the second entry.

You can use the CLI to reorder entries within an ACL by individually removing the ACL entries and then re-adding them. To use this method, enter “**no**” followed by the command for an ACL entry, and repeat this for each ACL entry in the ACL you want to edit. After removing all the ACL entries from the ACL, re-add them.

This method works well for small ACLs such as the example above, but can be impractical for ACLs containing many entries. Therefore, HP devices provide an alternative method. The alternative method lets you upload an ACL list from a TFTP server and replace the ACLs in the device’s running-config file with the uploaded list. Thus, to change an ACL, you can edit the ACL on the file server, then upload the edited ACL to the device. You then can save the changed ACL to the device’s startup-config file.

ACL lists contain only the ACL entries themselves, not the assignments of ACLs to interfaces. You must assign the ACLs on the device itself.

NOTE: The only valid commands that are valid in the ACL list are the **access-list** and **end** commands. The HP device ignores other commands in the file.

To modify an ACL by configuring an ACL list on a file server:

1. Use a text editor to create a new text file. When you name the file, use 8.3 format (up to eight characters in the name and up to three characters in the extension).

   NOTE: Make sure the HP device has network access to the TFTP server.

2. Optionally, clear the ACL entries from the ACLs you are changing by placing commands such as the following at the top of the file:

   ```
   no access-list 1
   no access-list 101
   ```

   When you load the ACL list into the device, the software adds the ACL entries in the file after any entries that already exist in the same ACLs. Thus, if you intend to entirely replace an ACL, you must use the **no access-list** <num> command to clear the entries from the ACL before the new ones are added.

3. Place the commands to create the ACL entries into the file. The order of the separate ACLs does not matter, but the order of the entries within each ACL is important. The software applies the entries in an ACL in the order they are listed within the ACL. Here is an example of some ACL entries:

   ```
   access-list 1 deny host 209.157.22.26 log
   access-list 1 deny 209.157.22.0 0.0.0.255 log
   access-list 1 permit any
   access-list 101 deny tcp any any eq http log
   ```

   The software will apply the entries in ACL 1 in the order shown and stop at the first match. Thus, if a packet is denied by one of the first three entries, the packet will not be permitted by the fourth entry, even if the packet matches the comparison values in this entry.

4. Enter the command "**end**" on a separate line at the end of the file. This command indicates to the software that the entire ACL list has been read from the file.

5. Save the text file.

6. On the HP device, enter the following command at the Privileged EXEC level of the CLI:

   copy tftp running-config <tftp-ip-addr> <filename>

   NOTE: This command will be unsuccessful if you place any commands other than **access-list** and **end** (at the end only) in the file. These are the only commands that are valid in a file you load using the **copy tftp running-config…** command.

7. To save the changes to the device's startup-config file, enter the following command at the Privileged EXEC level of the CLI:

   write memory

Here is a complete example of an ACL configuration file.

```
no access-list 1
no access-list 101
access-list 1 deny host 209.157.22.26 log
access-list 1 deny 209.157.22.0 0.0.0.255 log
access-list 1 permit any
access-list 101 deny tcp any any eq http log
end
```

NOTE: Do not place other commands in the file. The HP device reads only the ACL information in the file and ignores other commands, including **ip access-group** commands. To assign ACLs to interfaces, use the CLI.

Applying an ACL to a Subset of Ports on a Virtual Interface

You can apply an ACL to a virtual routing interface. The virtual interface is used for routing between VLANs and contains all the ports within the VLAN. If the ACL is for the inbound traffic direction, you also can specify a subset of ports within the VLAN containing a specified virtual interface when assigning an ACL to that virtual interface.

Use this feature when you do not want the ACLs to apply to all the ports in the virtual interface's VLAN or when you want to streamline ACL performance for the VLAN.

NOTE: This feature applies only to a virtual interface's inbound direction. You cannot use this feature to specify a subset of ports for a virtual interface's outbound direction.

To apply an ACL to a subset of ports within a virtual interface, enter commands such as the following:

```
HP9300(config)# vlan 10 name IP-subnet-vlan
HP9300(config-vlan-10)# untag ethernet 1/1 to 2/12
HP9300(config-vlan-10)# router-interface ve 1
HP9300(config-vlan-10)# exit
HP9300(config)# access-list 1 deny host 209.157.22.26 log
HP9300(config)# access-list 1 deny 209.157.29.12 log
HP9300(config)# access-list 1 deny host IPHost1 log
HP9300(config)# access-list 1 permit any
HP9300(config)# interface ve 1
HP9300(config-vif-1)# ip access-group 1 in ethernet 1/1 ethernet 1/3 ethernet 2/1 to
2/4
```

The commands in this example configure port-based VLAN 10, add ports 1/1 – 2/12 to the VLAN, and add virtual routing interface 1 to the VLAN. The commands following the VLAN configuration commands configure ACL 1. Finally, the last two commands apply ACL 1 to a subset of the ports associated with virtual interface 1.

Syntax: [no] ip access-group <num> in ethernet <portnum> [<portnum>...] to <portnum>

Enabling Strict TCP or UDP Mode

By default, when you use ACLs to filter TCP or UDP traffic, the HP device does not compare all TCP or UDP packets against the ACLs.

- TCP – By default, the device compares TCP control packets against the ACLs, but not data packets. Control packets include packet types such as SYN (Synchronization) packets, FIN (Finish) packets, and RST (Reset) packets
- UDP – By default, the device compares the source and destination information against entries in the session table. The session table contains forwarding entries based on Layer 3 and Layer 4 information.
    - If the session table contains a matching entry, the device forwards the packet, assuming that the first packet the device received that contains the same address information was permitted by the ACLs.
    - If the session table does not contain a matching entry, the device sends the packet to the CPU, where the software compares the packet against the ACLs. If the ACLs permit the packet (explicitly by a permit ACL entry or implicitly by the absence of a deny ACL entry), the CPU creates a session table entry for the packet's forwarding information and forwards the packet.

For tighter access or forwarding control, you can enable the device to perform strict TCP or UDP ACL processing. Strict ACL processing causes every TCP or UDP packet to go to the CPU for examination. The following sections describe the strict modes in more detail.

Enabling Strict TCP Mode

By default, when you use ACLs to filter TCP traffic, the HP device does not compare all TCP packets against the ACLs. Instead, the device compares TCP control packets against the ACLs, but not data packets. Control packets include packet types such as SYN (Synchronization) packets, FIN (Finish) packets, and RST (Reset) packets.

In normal TCP operation, TCP data packets are present only if a TCP control session for the packets also is established. For example, data packets for a session never occur if the TCP SYN for that session is dropped. Therefore, by filtering the control packets, the HP device also implicitly filters the data packets associated with the control packets. This mode of filtering optimizes forwarding performance for TCP traffic by forwarding data packets without examining them. Since the data packets are present in normal TCP traffic only if a corresponding TCP control session is established, comparing the packets for the control session to the ACLs is sufficient for filtering the entire session including the data.

However, it is possible to generate TCP data packets without corresponding control packets, in test or research situations for example. In this case, the default ACL mode does not filter the data packets, since there is no corresponding control session to filter. To filter this type of TCP traffic, use the strict ACL TCP mode. This mode compares all TCP packets to the configured ACLs, regardless of whether the packets are control packets or data packets.

Regardless of whether the strict mode is enabled or disabled, the device always compares TCP control packets against the configured ACLs.

To enable the strict ACL TCP mode, use the following CLI method.

NOTE: If the device's configuration currently has ACLs associated with interfaces, remove the ACLs from the interfaces before changing the ACL mode.

To enable the strict ACL TCP mode, enter the following command at the global CONFIG level of the CLI:

```
HP9300(config)# ip strict-acl-tcp
```

Syntax: [no] ip strict-acl-tcp

This command configures the device to compare all TCP packets against the configured ACLs before forwarding them.

To disable the strict ACL mode and return to the default ACL behavior, enter the following command:

```
HP9300(config)# no ip strict-acl-tcp
```

Enabling Strict UDP Mode

By default, when you use ACLs to filter UDP traffic, the HP device does not compare all UDP packets against the ACLs. Instead, the device does the following:

- Compares the source and destination information against entries in the session table. The session table contains forwarding entries based on Layer 3 and Layer 4 information.
  - If the session table contains a matching entry, the device forwards the packet, assuming that the first packet the device received that contains the same address information was permitted by the ACLs.
  - If the session table does not contain a matching entry, the device sends the packet to the CPU, where the software compares the packet against the ACLs. If the ACLs permit the packet (explicitly by a permit ACL entry or implicitly by the absence of a deny ACL entry), the CPU creates a session table entry for the packet's forwarding information and forwards the packet.

For tighter control, the software provides the strict ACL UDP mode. When you enable strict UDP processing, the device sends every UDP packet to the CPU and compares the packet against the configured ACLs.

To enable the strict ACL UDP mode, use the following CLI method.

NOTE: If the device's configuration currently has ACLs associated with interfaces, remove the ACLs from the interfaces before changing the ACL mode.

To enable the strict ACL UDP mode, enter the following command at the global CONFIG level of the CLI:

```
HP9300(config)# ip strict-acl-udp
```

Syntax: [no] ip strict-acl-udp

This command configures the device to compare all UDP packets against the configured ACLs before forwarding them.

To disable the strict ACL mode and return to the default ACL behavior, enter the following command:

```
HP9300(config)# no ip strict-acl-udp
```

Displaying ACLs

To display the ACLs configured on a device, use the following method.

USING THE CLI

To display detailed information for the ACLs and their entries, enter the following command at any level of the CLI.

```
HP9300(config)# show access-list
```

```
Access-list = 101
 TCP  applicable filters
 Port  80
  den y M:209.157.22.26:255.255.255.255
M:209.157.22.26:255.255.255.255,    tcp eq    80 log
      Any other por  t applicable filters
 UDP  applicable filters
      Any other por  t applicable filters
 ICMP  applicable filters
 Othe r protocol applicable filters
```

Syntax: show access-list [<num>]

To display the syntax for the entries in the ACLs, enter the **show ip access-lists** command. Here is an example:

```
HP9300(config)# show access-list
Extended IP access list 101
  d  eny tcp host 209.157.22.26 host 209.157.22.26 eq http log
```

Syntax: show ip access-lists [<num>]

Displaying the Log Entries

The first time an entry in an ACL denies a packet and logging is enabled for that entry, the software generates a Syslog message and an SNMP trap. Messages for packets denied by ACLs are at the warning level of the Syslog.

When the first Syslog entry for a packet denied by an ACL is generated, the software starts a five-minute ACL timer. After this, the software sends Syslog messages every five minutes. The messages list the number of packets denied by each ACL during the previous five-minute interval. If an ACL entry does not deny any packets during the five-minute interval, the software does not generate a Syslog entry for that ACL entry.

NOTE: For an ACL entry to be eligible to generate a Syslog entry for denied packets, logging must be enabled for the entry. The Syslog contains entries only for the ACL entries that deny packets and have logging enabled.

To display Syslog entries, use one of the following methods.

USING THE CLI

Enter the following command from any CLI prompt:

```
HP9300(config)# show log

Syslog logging: enabled (0 messages dropped, 0 flushes, 0 overruns)
  B  uffer logging: level ACDMEINW, 38 messages logged
  l  evel code: A=alert C=critical D=debugging M=emergency E=error
          I=inf      ormational N=notification W=warning

Log Buffer (50 entries):

21d07h02m40s:warning:list 101 denied tcp 209.157.22.191(0)(Ethernet 4/18
0010.5a1f.77ed) -> 198.99.4.69(http), 2 packets

00d07h03m30s:warning:list 101 denied tcp 209.157.22.26(0)(Ethernet 4/18
0010.5a1f.77ed) -> 198.99.4.69(http), 2 packets

00d06h58m30s:warning:list 101 denied tcp 209.157.22.198(0)(Ethernet 4/18
0010.5a1f.77ed) -> 198.99.4.69(http), 1 packets
```

In this example, the two-line message at the bottom is the first entry, which the software immediately generates the first time an ACL entry permits or denies a packet. In this case, an entry in ACL 101 denied a packet. The packet was a TCP packet from host 209.157.22.198 and was destined for TCP port 80 (HTTP) on host 198.99.4.69.

When the software places the first entry in the log, the software also starts the five-minute timer for subsequent log entries. Thus, five minutes after the first log entry, the software generates another log entry and SNMP trap for denied packets.

In this example, the software generates the second log entry five minutes later. The second entry indicates that the same ACL denied two packets.

The time stamp for the third entry is much later than the time stamps for the first two entries. In this case, no ACLs denied packets for a very long time. In fact, since no ACLs denied packets during the five-minute interval following the second entry, the software stopped the ACL log timer. The software generated the third entry as soon as the ACL denied a packet. The software restarted the five-minute ACL log timer at the same time. As long as at least one ACL entry permits or denies a packet, the timer continues to generate new log entries and SNMP traps every five minutes.

USING THE WEB MANAGEMENT INTERFACE

1. Select the Show link to display the Show Statistics panel.
2. Select the System Log link.

Policy-Based Routing (PBR)

Policy-Based Routing (PBR) allows you to use ACLs and route maps to selectively modify and route IP packets based on their source IP address.

NOTE: PBR is supported only on chassis routing switches.

NOTE: Source routing occurs in the CPU, not in the ASICs.

You can configure the routing switch to perform the following types of PBR based on a packet's Layer 3 and Layer 4 information:

- Select the next-hop gateway. (See "Configuration Examples" on page 3-27 for a complete configuration example.)

- Specify the default next-hop IP address if there is no explicit next-hop selection for the packet.
- Send the packet to the null interface (null0).

HP's PBR routing is based on standard and extended ACLs and route-maps. The ACLs classify the traffic. Route maps that match on the ACLs set routing attributes for the traffic. HP's implementation of PBR uses high performance switching algorithms including route caches and route tables.

Configuring PBR

To configure PBR:

- Configure ACLs that contain the source IP addresses for the IP traffic to which you want to apply PBR.
- Configure a route map that matches on the ACLs and sets route information.
- Apply the route map globally or to individual interfaces.

NOTE: All the procedures in the following sections are for the CLI.

Configure the ACLs

PBR uses route maps to change the routing attributes in IP traffic. This section shows an example of how to configure a standard ACL to identify the source sub-net for IP traffic.

To configure a standard ACL to identify a source sub-net, enter a command such as the following:

```
HP9300(config)# access-list 1 permit 209.157.23.0 0.0.0.255
```

The command in this example configures a standard ACL that permits traffic from sub-net 209.157.23.0/24. After you configure a route map that matches based on this ACL, the software uses the route map to set route attributes for the traffic, thus enforcing PBR.

NOTE: Do not use an access group to apply the ACL to an interface. Instead, use a route map to apply the ACL globally or to individual interfaces for PBR, as shown in the following sections.

Syntax: [no] access-list <num> deny | permit <source-ip> | <hostname> <wildcard> [log]

or

Syntax: [no] access-list <num> deny | permit <source-ip>/<mask-bits> | <hostname> [log]

Syntax: [no] access-list <num> deny | permit host <source-ip> | <hostname> [log]

Syntax: [no] access-list <num> deny | permit any [log]

The <num> parameter is the access list number and can be from 1 – 99.

The **deny | permit** parameter indicates whether packets that match a policy in the access list are denied (dropped) or permitted (forwarded).

NOTE: If you are configuring the ACL for use in a route map, always specify **permit**. Otherwise, the routing switch drops the traffic instead of further processing the traffic using the route map.

The <source-ip> parameter specifies the source IP address. Alternatively, you can specify the host name.

NOTE: To specify the host name instead of the IP address, the host name must be configured using the HP device's DNS resolver. To configure the DNS resolver name, use the **ip dns server-address…** command at the global CONFIG level of the CLI.

The <wildcard> parameter specifies the mask value to compare against the host address specified by the <source-ip> parameter. The <wildcard> is a four-part value in dotted-decimal notation (IP address format) consisting of ones and zeros. Zeros in the mask mean the packet's source address must match the <source-ip>. Ones mean any value matches. For example, the <source-ip> and <wildcard> values 209.157.22.26 0.0.0.255 mean that all hosts in the Class C sub-net 209.157.22.x match the policy.

If you prefer to specify the wildcard (mask value) in CIDR format, you can enter a forward slash after the IP address, then enter the number of significant bits in the mask. For example, you can enter the CIDR equivalent of “209.157.22.26 0.0.0.255” as “209.157.22.26/24”. The CLI automatically converts the CIDR number into the appropriate ACL mask (where zeros instead of ones are the significant bits) and changes the non-significant portion of the IP address into zeros. For example, if you specify 209.157.22.26/24 or 209.157.22.26 0.0.0.255, then save the changes to the startup-config file, the value appears as 209.157.22.0/24 (if you have enabled display of sub-net lengths) or 209.157.22.0 0.0.0.255 in the startup-config file.

If you enable the software to display IP sub-net masks in CIDR format, the mask is saved in the file in “/<mask-bits>” format. To enable the software to display the CIDR masks, enter the **ip show-subnet-length** command at the global CONFIG level of the CLI. You can use the CIDR format to configure the ACL entry regardless of whether the software is configured to display the masks in CIDR format.

NOTE: If you use the CIDR format, the ACL entries appear in this format in the running-config and startup-config files, but are shown with sub-net mask in the display produced by the **show access-list** and **show ip access-list** commands.

The **host** <source-ip> | <hostname> parameter lets you specify a host IP address or name. When you use this parameter, you do not need to specify the mask. A mask of all zeros (0.0.0.0) is implied.

The **any** parameter configures the policy to match on all host addresses.

The **log** argument configures the device to generate Syslog entries and SNMP traps for packets that are permitted or denied by the access policy.

NOTE: You can enable logging on ACLs and filters that support logging even when the ACLs and filters are already in use. To do so, re-enter the ACL or filter command and add the **log** parameter to the end of the ACL or filter. The software replaces the ACL or filter command with the new one. The new ACL or filter, with logging enabled, takes effect immediately.

Configure the Route Map

After you configure the ACLs, you can configure a PBR route map that matches based on the ACLs and sets routing information in the IP traffic.

For example, to configure a PBR route map named “test-route”, you would enter the following commands:

```
HP9300(config)# route-map test-route permit 1
HP9300(config-routemap test-route)# match ip address 1
HP9300(config-routemap test-route)# set ip next-hop 192.168.2.1
HP9300(config-routemap test-route)# exit
```

The commands in this example configure an entry in a route map named “test-route”. The **match** statement matches on IP information in ACL 1. The **set** statement changes the next-hop IP address for packets that match to 192.168.2.1.

Syntax: route-map <map-name> permit | deny <num>

The <map-name> is a string of characters that names the map. Map names can be up to 32 characters in length. You can define up 50 route maps on the routing switch.

The **permit | deny** parameter specifies the action the routing switch will take if a route matches a match statement.

- If you specify **deny**, the routing switch does not advertise or learn the route.
- If you specify **permit**, the routing switch applies the match and set statements associated with this route map instance.

The <num> parameter specifies the instance of the route map you are defining. Each route map can have up to 50 instances. Routes are compared to the instances in ascending numerical order. For example, a route is compared to instance 1, then instance 2, and so on.

Syntax: match ip address <ACL-num-or-name>

The <ACL-num> parameter specifies a standard or extended ACL number or name.

Syntax: set ip [default] next hop <ip-addr>

This command sets the next-hop IP address for traffic that matches a match statement in the route map.

If you specify **default**, the route map sets the next-hop gateway only if the routing switch does not already have explicit routing information for the traffic.

Syntax: set [default] interface null0

This command redirects the traffic to the specified interface. You can send the traffic to the null0 interface, which is the same as dropping the traffic.

If you specify **default**, the route map redirects the traffic to the specified interface only if the routing switch does not already have explicit routing information for the traffic.

Enabling PBR

After you configure the ACLs and route map entries, you can enable PBR globally, on individual interfaces, or both as described in this section. To enable PBR, you apply a route map you have configured for PBR globally or locally.

Enabling PBR Globally

To enable PBR globally, enter a command such as the following at the global CONFIG level:

```
HP9300(config)# ip policy route-map test-route
```

This command applies a route map named “test-route” to all interfaces on the device for PBR.

Syntax: ip policy route-map <map-name>

Enabling PBR Locally

To enable PBR locally, enter commands such as the following:

```
HP9300(config)# interface ve 1
HP9300(config-vif-1)# ip policy route-map test-route
```

The commands in this example change the CLI to the Interface level for virtual interface 1, then apply the “test-route” route map to the interface. You can apply a PBR route map to Ethernet ports or virtual interfaces.

Syntax: ip policy route-map <map-name>

Configuration Examples

The following sections provide configuration examples for the following uses of PBRs:

- Setting the next hop
- Setting the next hop, if the routing switch does not have an explicit next hop configured for the traffic
- Discarding traffic by sending it to a null interface

Setting the Next Hop

The following commands configure the routing switch to apply PBR to traffic from IP sub-nets 209.157.23.x, 209.157.24.x, and 209.157.25.x. In this example, route maps specify the next-hop gateway for packets from each of these sub-nets.

- Packets from 209.157.23.x are sent to 192.168.2.1.
- Packets from 209.157.24.x are sent to 192.168.2.2.
- Packets from 209.157.25.x are sent to 192.168.2.3.

The following commands configure three standard ACLs. Each ACL contains one of the ACLs listed above. Make sure you specify **permit** instead of deny in the ACLs, so that the routing switch permits the traffic that matches the

ACLs to be further evaluated by the route map. If you specify **deny**, the routing switch denies the traffic from further evaluation and instead drops the packets. Notice that these ACLs specify **any** for the destination address.

```
HP9300(config)# access-list 1 permit 209.157.23.0 0.0.0.255
HP9300(config)# access-list 2 permit 209.157.24.0 0.0.0.255
HP9300(config)# access-list 3 permit 209.157.25.0 0.0.0.255
```

The following commands configure three entries in a route map called “test-route”. The first entry (permit 1) matches on the IP address information in ACL 1 above. For IP traffic from sub-net 209.157.23.0/24, this route map entry sets the next-hop IP address to 192.168.2.1.

```
HP9300(config)# route-map test-route permit 1
HP9300(config-routemap test-route)# match ip address 1
HP9300(config-routemap test-route)# set ip next-hop 192.168.2.1
HP9300(config-routemap test-route)# exit
```

The following commands configure the second entry in the route map. This entry (permit 2) matches on the IP address information in ACL 2 above. For IP traffic from sub-net 209.157.24.0/24, this route map entry sets the next-hop IP address to 192.168.2.2.

```
HP9300(config)# route-map test-route permit 2
HP9300(config-routemap test-route)# match ip address 2
HP9300(config-routemap test-route)# set ip next-hop 192.168.2.2
HP9300(config-routemap test-route)# exit
```

The following commands configure the third entry in the test-route route map. This entry (permit 3) matches on the IP address information in ACL 3 above. For IP traffic from sub-net 209.157.25.0/24, this route map entry sets the next-hop IP address to 192.168.2.3.

```
HP9300(config)# route-map test-route permit 3
HP9300(config-routemap test-route)# match ip address 3
HP9300(config-routemap test-route)# set ip next-hop 192.168.2.3
HP9300(config-routemap test-route)# exit
```

The following command enables PBR by globally applying the test-route route map to all interfaces.

```
HP9300(config)# ip policy route-map test-route
```

Alternatively, you can enable PBR on specific interfaces, as shown in the following example. The commands in this example configure IP addresses in the three source sub-nets identified in ACLS 1, 2, and 3, then apply route map test-route the interface.

```
HP9300(config)# interface ve 1
HP9300(config-vif-1)# ip address 209.157.23.1/24
HP9300(config-vif-1)# ip address 209.157.24.1/24
HP9300(config-vif-1)# ip address 209.157.25.1/24
HP9300(config-vif-1)# ip policy route-map test-route
```

Setting the Next Hop When no Next Hop Is Explicitly Configured

The following commands configure a PBR to set the next-hop gateway for traffic, but only if the routing switch does not already have a next-hop gateway specified for the traffic. In this example, a route map specifies the next-hop gateway for packets from sub-net 192.168.1.x.

The following command configures a standard ACL for the sub-net.

```
HP9300(config)# access-list 4 permit 192.168.1.0 0.0.0.255 any
```

The following commands configure an entry in a route map called “test-route-if-no-gateway”. The first entry (permit 4) matches on the IP address information in ACL 4 above. For IP traffic from sub-net 192.168.1.0/24, this route map entry sets the next-hop IP address to 192.111.1.1, but only if the routing switch does not already have a gateway configured for the sub-net.

```
HP9300(config)# route-map test-route-if-no-gateway permit 4
HP9300(config-routemap test-route-if-no-gateway)# match ip address 4
HP9300(config-routemap test-route-if-no-gateway)# set ip default next-hop
192.111.1.1
```

```
HP9300(config-routemap test-route-if-no-gateway)# exit
```

The following command enables PBR by globally applying the route map to all interfaces.

```
HP9300(config)# ip policy route-map test-route-if-no-gateway
```

Alternatively, you can enable PBR on specific interfaces, as shown in the following example. The commands in this example configure IP addresses in the source sub-net identified in ACL 4, then apply route map test-route-if-no-gateway to the interface.

```
HP9300(config)# interface ve 2
HP9300(config-vif-1)# ip address 192.168.1.34/24
HP9300(config-vif-1)# ip policy route-map test-route-if-no-gateway
```

Setting the Output Interface to the Null Interface

The following commands configure a PBR to send all traffic from 192.168.1.204/32 to the null interface, thus dropping the traffic instead of forwarding it.

```
HP9300(config)# access-list 6 permit 209.168.1.204 0.0.0.0
```

The following commands configure an entry in a route map called “file-13”. The first entry (permit 6) matches on the IP address information in ACL 6 above. For IP traffic from the host 209.168.1.204/32, this route map entry sends the traffic to the null interface instead of forwarding it, thus sparing the rest of the network the unwanted traffic.

```
HP9300(config)# route-map file-13 permit 6
HP9300(config-routemap file-13)# match ip address 6
HP9300(config-routemap file-13)# set interface null0
HP9300(config-routemap file-13)# exit
```

The following command enables PBR by globally applying the route map to all interfaces.

```
HP9300(config)# ip policy route-map file-13
```

Alternatively, you can enable the PBR on specific interfaces, as shown in the following example. The commands in this example configure IP addresses in the source sub-net identified in ACL 6, then apply route map file-13 to the interface.

```
HP9300(config)# interface ethernet 3/11
HP9300(config-if-3/11)# ip address 192.168.1.204/32
HP9300(config-if-3/11)# ip policy route-map file-13
```

Chapter 4
Rate Limiting

HP's rate limiting enables you to control the amount of bandwidth specific Ethernet traffic uses on specific interfaces, by limiting the amount of data the interface receives or forwards for traffic. You can configure the following types of rate limiting:

- Fixed Rate Limiting – Enforces a strict bandwidth limit. The device forwards traffic that is within the limit but drops all traffic that exceeds the limit.
- Adaptive Rate Limiting – Enforces a flexible bandwidth limit that allows for bursts above the limit. You can configure Adaptive Rate Limiting to forward, modify the IP precedence of and forward, or drop traffic based on whether the traffic is within the limit or exceeds the limit.

Rate limiting is supported on the HP 9304M and HP 9308M.

Fixed Rate Limiting

Fixed Rate Limiting allows you to specify the maximum number of Ethernet bytes a given port can send or receive. The port drops bytes that exceed the limit you specify. You can configure a Fixed Rate Limiting policy on a port's inbound or outbound direction. The rate limit applies only to the direction you specify.

Fixed Rate Limiting applies to all types of traffic on the port.

When you specify the maximum number of bytes, you specify it in bits per second (bps). The Fixed Rate Limiting policy applies to one-second intervals and allows the port to send or receive the number of bytes you specify in the policy, but drops additional bytes.

NOTE: HP recommends that you do not use Fixed Rate Limiting on ports that send or receive route control traffic or Spanning Tree Protocol (STP) control traffic. If the port drops control packets due to the Fixed Rate Limiting policy, routing or STP can be disrupted.

How Fixed Rate Limiting Works

Fixed Rate Limiting counts the number of bytes that a port either sends or receives, in one second intervals. The direction that the software monitors depends on the direction you specify when you configure the rate limit on the port. If the number of bytes exceeds the maximum number you specify when you configure the rate, the port drops all further packets for the rate-limited direction, for the duration of the one-second interval.

Once the one-second interval is complete, the port clears the counter and re-enables traffic.

Figure 4.1 shows an example of how Fixed Rate Limiting works. In this example, a Fixed Rate Limiting policy is applied to a port to limit the inbound traffic to 500000 bits (62500 bytes) a second. During the first two one-second

intervals, the port receives less than 500000 bits in each interval. However, the port receives more than 500000 bits during the third and fourth one-second intervals, and consequently drops the excess traffic.

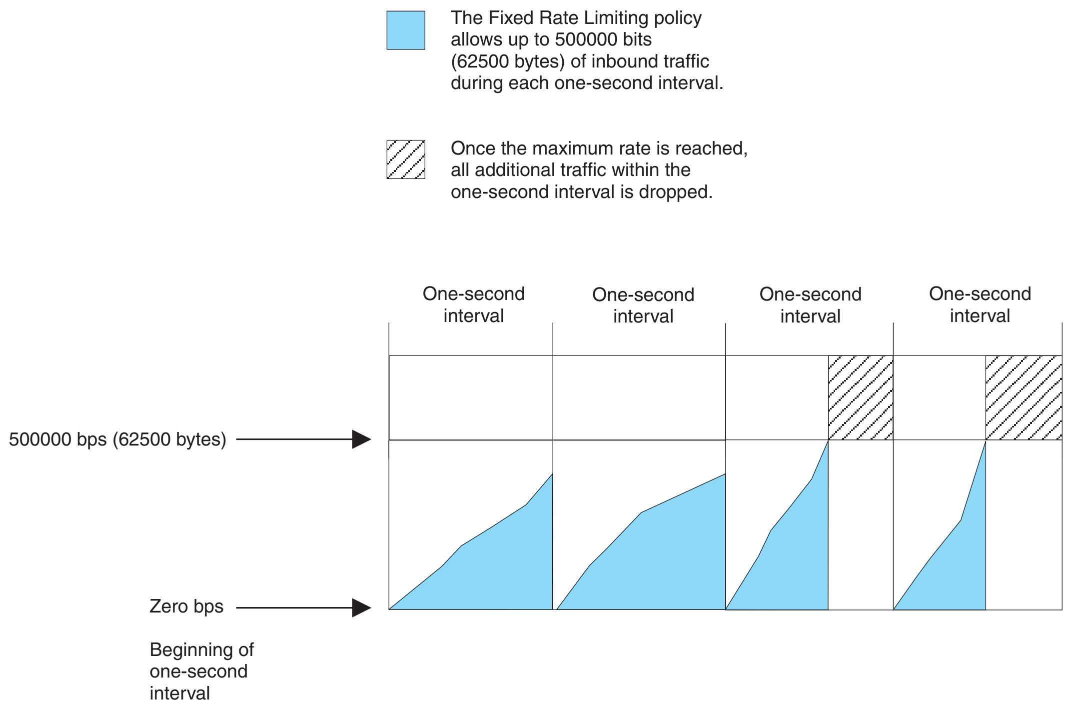


Figure 4.1 Fixed Rate Limiting

NOTE: The software counts the bytes by polling statistics counters for the port every 10 milliseconds, which provides 100 readings each second. Due to the polling interval, the Fixed Rate Limiting policy has an accuracy of within 1% of the port's line rate. It is therefore possible for the policy to sometimes allow more traffic than the limit you specify, but the extra traffic is never more than 1% of the port's line rate.

Configuring Fixed Rate Limiting

To configure a Fixed Rate Limiting policy, enter a command such as the following at the configuration level for a port:

```
HP9300(config-if-1/1)# rate-limiting input fixed 500000
```

This command configures a Fixed Rate Limiting policy that allows port 1/1 to receive a maximum of 500000 bps (62500 bytes per second). If the port receives additional bytes during a given one-second interval, the port drops all inbound packets on the port until the next one-second interval starts.

Syntax: [no] rate-limiting input | output fixed <rate>

The **input | output** parameter specifies whether the rate limit applies to inbound or outbound traffic on the port.

The <rate> parameter specifies the maximum rate for the port. Specify the rate in bits per second. You can specify from 1 up to any number. There is no default.

NOTE: If you specify a number that is larger than the port's line rate, the traffic will never cause the policy to go into effect.

Displaying Fixed Rate Limiting Information

To display configuration information and statistics for Fixed Rate Limiting, enter the following command at any level of the CLI:

```
HP9300(config)# show rate-limiting fixed

Total rate-limited interface count: 6.
  P  ort     Input rate   RX Enforced  Output rate    TX Enforced
     1/1         500000            3
     2/1                                 1234567          100
     2/2                                 2222222           3
     2/3                                 1234567          15
     2/4                                 1238888          12
     2/5                                 1238888           7
```

Syntax: show rate-limiting fixed

This display shows the following information.

Table 4.1: CLI Display of Fixed Rate Limiting Information

This Field...	Displays...
Total rate-limited interface count	The total number of ports that are configured for Fixed Rate Limiting.
Port	The port number.
Input rate	The maximum rate allowed for inbound traffic. The rate is measured in bits per second (bps).
RX Enforced	The number of one-second intervals in which the Fixed Rate Limiting policy has dropped traffic received on the port.
Output rate	The maximum rate allowed for outbound traffic. The rate is measured in bps.
TX Enforced	The number of one-second intervals in which the Fixed Rate Limiting policy has dropped traffic queued to be sent on the port.

Adaptive Rate Limiting

The Adaptive Rate Limiting enables you to configure rate policies that enforce bandwidth limits for Ethernet traffic. The features allows you to specify how much Ethernet traffic of a given type a specific port can send or receive, and also allows you to either change the IP precedence of the traffic before forwarding it or drop the traffic.

You can apply rate policies to the following types of interfaces, in the inbound or outbound direction:

- Individual ports
- Trunk groups
- Virtual interfaces (used for routing by VLANs)
- Layer 2 port-based VLANs

You can apply up to 20 rate policy rules to an interface for inbound traffic and up to 20 more rules for outbound traffic. The interface can have up to 20 rules for each traffic direction. The device applies the rules in the order you apply them to the interface.

NOTE: Adaptive Rate Limiting applies only to version 4 IP traffic.

NOTE: On Layer 2 devices and Layer 3 devices, you cannot apply rate limiting to a port if that port belongs to a VLAN that has a virtual interface. On Layer 3 devices, you cannot apply rate limiting to a port unless that port already has an IP address configured.

You can configure rate policies for the following types of traffic:

- Layer 3 IP traffic
- Specific source or destination IP addresses or networks
- Specific source or destination TCP or UDP application ports
- Specific MAC addresses
- Specific IP precedence values or Diffserv control points

NOTE: Rate limiting for Diffserv is not supported in the current release.

The rate policies you apply to an interface affect only the traffic types you specify and allows other traffic to be sent or received without rate limiting.

The rate policy rules allow to specify the action you want the HP device to take depending on whether the traffic is conforming to the policy. You can specify one of the following actions for each case:

- Forward the traffic
- Drop the traffic
- Change the IP precedence or Diffserv control point and forward the traffic
- Change the IP precedence or Diffserv control point, then continue comparing the traffic to the rate policy rules
- Continue comparing the traffic to the rate policy rules without changing the IP precedence or Diffserv control point

The following sections provide examples of Adaptive Rate Limiting, an explanation of how the feature works, and configuration procedures.

Examples of Adaptive Rate Limiting Applications

The following sections show some examples of how you can use Adaptive Rate Limiting. The CLI commands for implementing each application are shown in “Complete CLI Examples” on page 4-18.

Adaptive Rate Policies For an Uplink

Figure 4.2 shows an example of how you can use the Adaptive Rate Limiting. In this example, four rate policies are applied to the device’s uplink to the Internet. In this case, the uplink is a trunk group consisting of two one-Gigabit Ethernet ports.

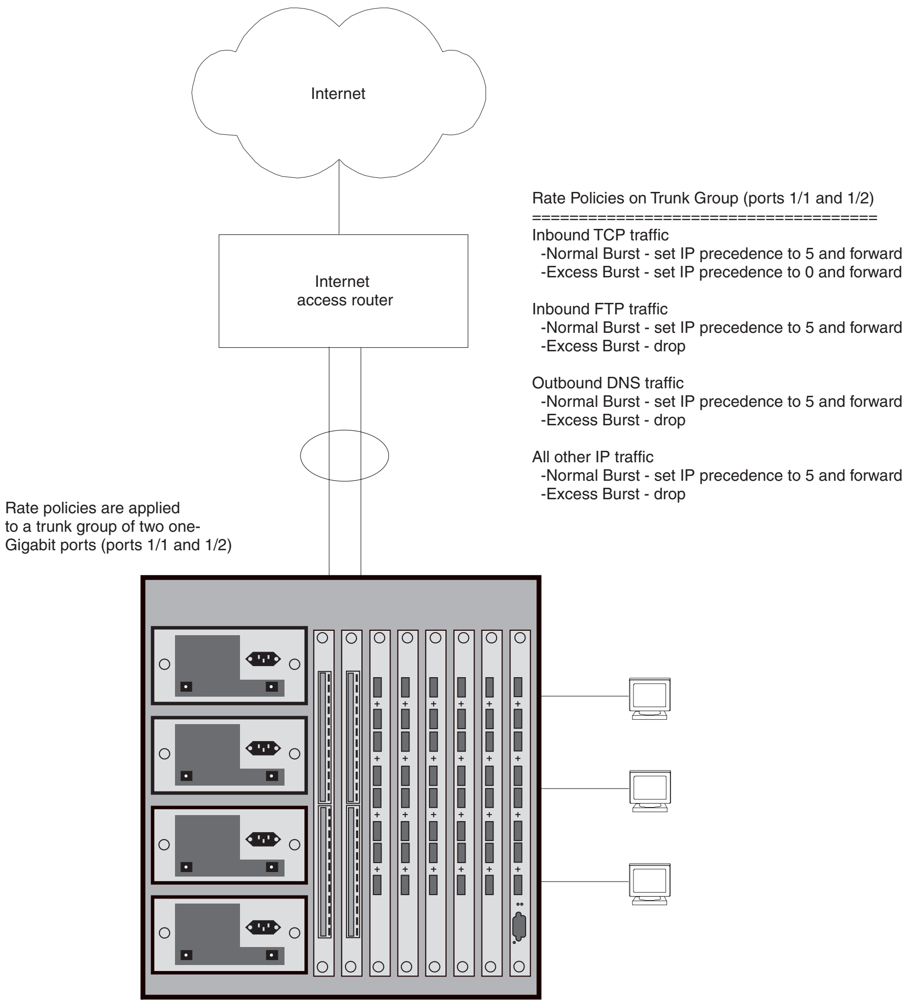


Figure 4.2 Adaptive Rate Limiting applied to uplink

The rate policy rules are for three TCP/UDP applications: HTTP (web), FTP, and DNS. The fourth rule is for all other Ethernet traffic (traffic that is not for one of the three applications). The device applies rate policy rules in the order in which you apply them to an interface. In this case, the rules are applied in the following order:

- Inbound TCP traffic
- Inbound FTP traffic
- Outbound DNS traffic
- All other inbound Ethernet traffic

Notice that each rule is associated with a traffic direction. You can apply a given rate policy rule to traffic received on an interface, sent on an interface, or both.

For each rule, the device counts the bytes that apply to the rule during each Committed Time Interval (time interval, which can be from 1/10th second up to one second). The device takes the conform action, which is action specified by the rule for Normal Burst Size, so long as the number of bytes for the traffic is within the Normal Burst Size value. Once the number of bytes exceeds the Normal Burst Size and thus enters the Excess Burst Size, the device takes the exceed action. “How Adaptive Rate Limiting Works” on page 4-10 describes how the byte counters for the Normal Burst Size and Excess Burst Size are incremented.

Each rule incudes one of the following actions depending on whether the traffic is conforming with the Normal Burst Size or has exceeded the Normal Burst Size:

- Forward the traffic
- Drop the traffic
- Change the IP precedence or Diffserv control point and forward the traffic
- Change the IP precedence or Diffserv control point, then continue comparing the traffic to the rate policy rules
- Continue comparing the traffic to the rate policy rules without changing the IP precedence or Diffserv control point

In Figure 4.2, all of the policies set the IP precedence to 5 (critical) for in traffic that conforms to the Normal Burst Size. In other words, for all packets up to the maximum number of bytes specified by the Normal Burst Size, the device sets the precedence in each packet to 5.

The policies take different actions for traffic in the Excess Burst Size. Some policies set the precedence and forward the traffic while other policies drop the traffic. In Figure 4.2, the rule for HTTP traffic sets the precedence to zero (routine) for traffic in the Excess Burst Size. The other policies drop the traffic.

In all cases, after the maximum number of bytes for the Normal Burst Interval and the Excess Burst Size match a given rule, the software drops additional bytes that match the rule until the burst size counters are reset.

Adaptive Rate Policy for a Specific MAC Address

Figure 4.3 shows an example of a rate policy consisting of one rule applied to a virtual routing interface (“virtual interface” or “VE”). A virtual interface enables ports in a VLAN to route to other VLANs. In this example, the VLAN contains three ports, attached to three hosts. The hosts use virtual interface ve2 for routing.

The rate policy in this example forwards all conforming traffic from the host with MAC address aaaa.bbbb.cccc but drops all additional traffic from the host. Conforming traffic is traffic within the Normal Burst Size specified in the rate policy. Within a given Committed Time Interval, if the host sends more bytes than the number of bytes allowed by the Normal Burst Size, the policy drops the excess bytes.

The other hosts in the VLAN do not have rules. As a result, their bandwidth is not limited.

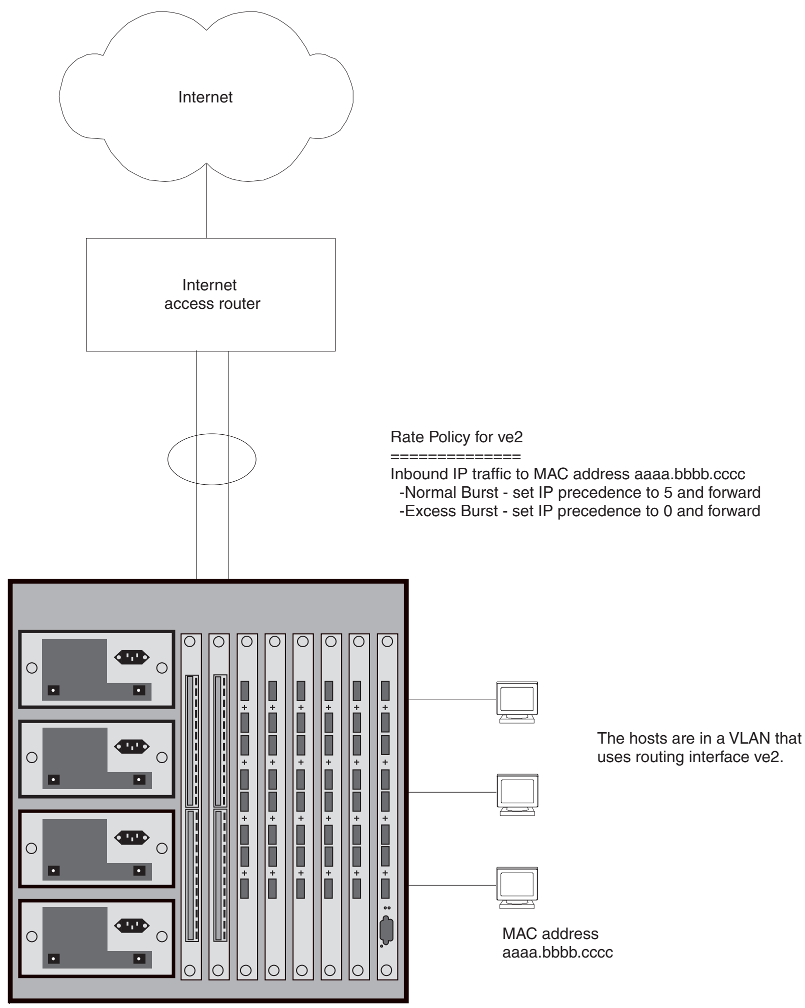


Figure 4.3 Adaptive Rate Limiting applied to virtual routing interface

The rule could be applied to the port attached to the host for the same results. However, since the rule is associated with the virtual interface instead of a physical port, the policy remains in effect even if the host moves to another port within the VLAN.

Adaptive Rate Policy for a Port-Based VLAN

Figure 4.4 shows a rate policy applied to a VLAN. When you apply a rate policy to a VLAN, the policy applies to all the ports in the VLAN. The rate policy in this example performs the following actions on traffic received on ports in the VLAN:

- For conforming traffic, sets the precedence to 5
- For excess traffic, sets the precedence to 0

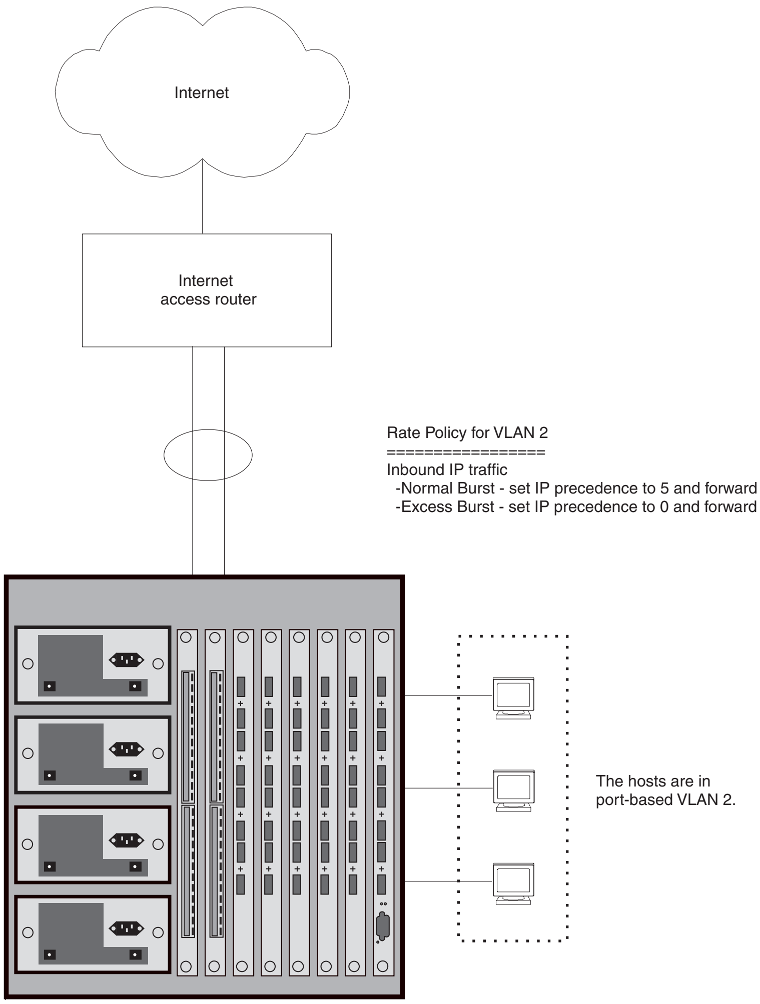


Figure 4.4 Adaptive Rate Limiting applied to a VLAN

NOTE: The rate policy in this example applies at Layer 2, while the policies in Figure 4.2 on page 4-5 and Figure 4.3 on page 4-7 apply at Layer 3. You cannot use ACLs for rate policies applied to directly to a VLAN. However, you can use ACLs if you apply the rate policy to a VLAN's virtual interface instead.

Adaptive Rate Limiting Parameters

The application examples in "Examples of Adaptive Rate Limiting Applications" on page 4-5 describe the rate policies but do not describe the parameters used to configure the policies. The parameters specify the portion of an interface's bandwidth you are allocating to specific traffic, the conforming and excess quantities of bytes for the traffic, and the granularity of the Adaptive Rate Limiting.

Adaptive Rate Limiting uses the following parameters:

- Average Rate
- Normal Burst Size
- Excess Burst Size
- Committed Time Interval

When you apply Adaptive Rate Limiting policies to an interface, you specify the first three of these parameters. The fourth parameter is derived from the first two.

NOTE: When you configure these parameters, express the Average Rate in bits. Express the Normal Burst Size and Excess Burst Size in bytes.

Average Rate

The Average Rate is a percentage of an interface's line rate (bandwidth), expressed as a number representing bits per second (bps). The value can be from 256Kbps up to the maximum line rate of the port. For example, for a 100Mbps port, the maximum value is 100,000,000 bps. If the interface contains multiple ports (for example, a trunk group or a virtual interface), the maximum value is the combined line rate of all the ports in the interface.

Normal Burst Size

The Normal Burst Size is the maximum number of bytes that specific traffic can send on a port within the Committed Time Interval, and still be within that traffic's rate limit. The minimum value is 3277 or 1/10th of the Average Rate (whichever is higher), and the maximum value is the Average Rate.

Excess Burst Size

The Excess Burst Size is the maximum number of additional bytes (bytes over the Normal Burst Size) within the Committed Time Interval that can be transmitted. The Excess Burst Size can be a value equal to or greater than the Normal Burst Size up to the maximum number of bytes the interface can forward within the Committed Time Interval (explained below).

Depending on how the rate limiting is configured, the device can take different actions for traffic within the Normal Burst Size and traffic that falls into the Excess Burst Size. For example, you can forward all traffic in the Normal Burst Size and reset the precedence to a lower priority for all Excess Burst Size traffic, or even just drop that traffic.

NOTE: Do not set the Excess Burst Size to a value greater than the maximum number of bytes the interface can forward within the Committed Time Interval. Even if the software allows you to specify a higher value, the interface cannot forward more data than its line rate supports.

Committed Time Interval

The Committed Time Interval is a value representing a slice of time on the interface where you apply the Adaptive Rate Limiting. The slice of time can be from 1/10th second up to one second. This parameter establishes the granularity of the Adaptive Rate Limiting. This parameter also determines the maximum value of the Excess Burst Size.

The Normal Burst Size counter increments during this slice of time, then reverts to zero when the next slice of time starts. The Excess Burst Time counter increments during every two Committed Time Intervals, then reverts to zero. See “How Adaptive Rate Limiting Works” on page 4-10.

The Committed Time Interval is not directly configurable, but is instead derived from the following formula:

- Normal Burst Size / Average Rate = Committed Time Interval

For example, you can configure parameters for a port as follows:

- Average Rate (in bits) = 10000000
- Normal Burst Size (in bytes) = 12500 (1000000 bits), which is 1/10th the Average Rate. 1/10th is the minimum value.

Thus, the Committed Time Interval is 1000000 bits / 10000000 bits = 0.1 seconds. This means that the Adaptive Rate Limiting parameters apply to time slices of bandwidth 0.1 seconds long.

To determine the maximum Excess Burst Size you can specify, use the Average Rate and Normal Burst Size you specified to calculate the Committed Time Interval. Then divide the interface's maximum line rate by the Committed Time Interval. Here are some examples:

- Assume that the interface is a 100Mbps port. The maximum line rate is therefore 100,000,000 bits per second, which is 12,500,000 bytes per second. Also assume that you specify an Average Rate of 40,000 bytes (320,000 bits / 8 = 40,000 bytes) and a Normal Burst Size of 4000 bytes. These values result in a Committed Time Interval of 0.1 (1/10th second). Multiply the interface's full line rate (12,500,000) by 0.1 to get 1,250,000. In this case, the maximum Excess Burst Size is 1250000 (1,250,000 bytes).
- Assume the same interface line rate, but specify an Average Rate of 80,000 bytes (640,000 bits / 8 = 80,000 bytes) and a Normal Burst Size of 8000 bytes. In this case, the Committed Time Interval is still 0.1 and the maximum Excess Burst Size is still 1,250,000 bytes.

Notice that in both of these examples, the Normal Burst Size is 1/10th the Average Rate, which in each case means the Committed Time Interval is 1/10th second. Because the interface's full line rate and the Committed Time Interval are the same in each case, the maximum Excess Burst Size is also the same in each case. However, the ratio of the Normal Burst Size to the Excess Burst Size in the examples is quite different.

How Adaptive Rate Limiting Works

HP's Adaptive Rate Limiting polices bandwidth usage on specific interfaces for specific Ethernet traffic, and takes the actions you specify based on whether the traffic is within the amount of bandwidth you have allocated for the traffic or has exceeded the bandwidth allocation.

Adaptive Rate Limiting provides this service by counting the number of Ethernet traffic bytes sent or received on an interface, then taking a specific action depending on whether the count is within the normal bandwidth allocation (Normal Burst Size) or has exceeded the allocation (Excess Burst Size).

Normal Burst Size and Excess Burst Size Counters

The Adaptive Rate Limiting counts bytes within each Committed Time Interval, which is a slice of time (and thus a portion of the line rate) on the interface.

- Normal Burst Size counter – The byte counter for the Normal Burst Size increments during each Committed Time Interval, and is reset to zero at the next interval. Thus, the policy takes the action for conforming traffic for all the Ethernet traffic's bytes up to the number of bytes specified by the Normal Burst Size.
- Excess Burst Size counter – The byte counter for the Excess Burst Size increments during each ***two*** Committed Time Intervals, and is reset to zero after every second interval. The policy takes the action for exceeding traffic for all the Ethernet traffic's bytes past the maximum Normal Burst Size and up to the maximum Excess Burst Size. The device drops traffic once the number of bytes exceeds the maximum Excess Burst Size. The device continues dropping the packets until the next Committed Time Interval, at which time the Normal Burst Size is reset to zero.

Figure 4.5 shows an example of the Normal Burst Size and Excess Burst Size counters. This example shows two Committed Time Intervals.

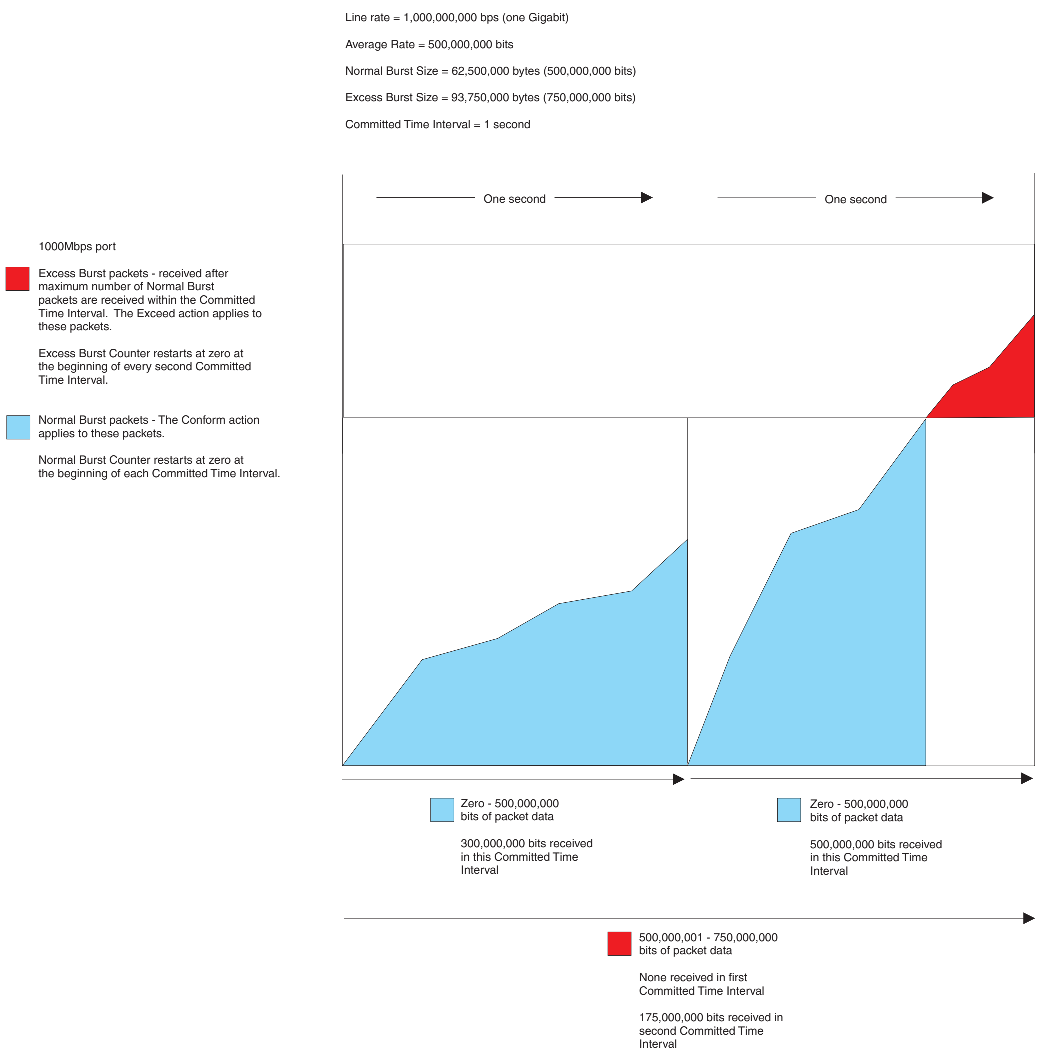


Figure 4.5 Normal and Excess Burst Size Counters

Notice that the counter for the Normal Burst Size counter restarts at the beginning of each Committed Time Interval, whereas the counter for the Excess Burst Size restarts after every two Committed Time Intervals. In this example, the policy rule on the interface matches 300,000,000 bits of Ethernet traffic data during the first Committed Time Interval. Therefore, all the traffic conformed to the policy rule and the software took the action specified for conforming traffic.

During the second Committed Time Interval, the policy rule on the interface matches 675,000,000 bits of Ethernet traffic data. Since the Normal Burst Size is 500,000,000, the software takes the conforming action for the first 500,000,000 bits. However, the software takes the exceed action for the remaining traffic. In this example, the action for conforming traffic is to set the IP precedence to 5, then forward the traffic. The action for exceed traffic is to set the IP precedence to 0, then forward the traffic.

Figure 4.6 shows an example of two Committed Time Intervals. In this example, the policy rule matches the maximum number of conforming bytes (Normal Burst Size bytes) in each interval.

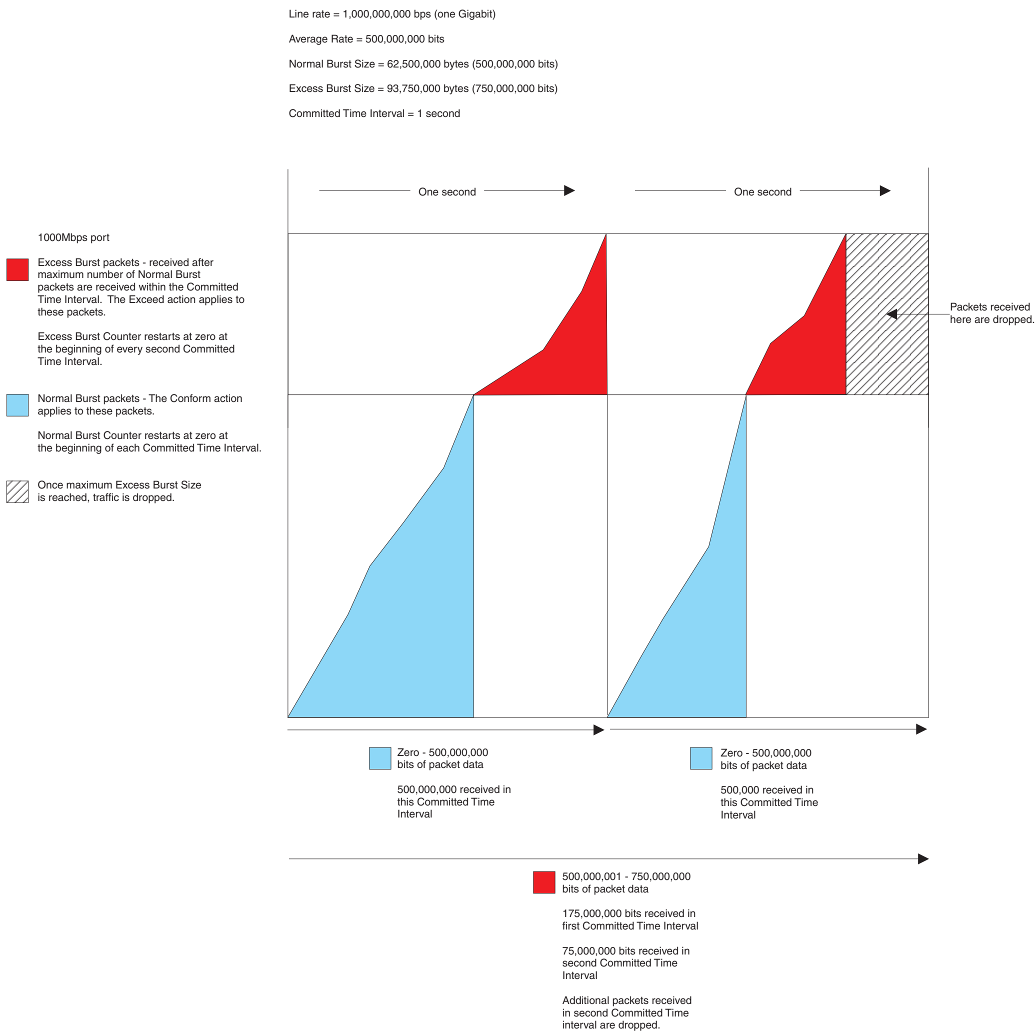


Figure 4.6 Excess Burst Size increments over every two Committed Time Intervals

The rule matches additional bytes in each interval, and thus applies the exceed action. The counter for the Excess Burst Size increments over the span of the two intervals. Thus, the number of Excess Burst Size bytes available for the second interval is the amount that remains after the first Committed Time Interval. In this example, the rule matches 175,000,000 bits of additional (Excess Burst Size) data in the first Committed Time Interval. The Excess Burst Size in the rule is set to 250,000,000 bits. As a result, only 75,000,000 Excess Burst Size bits are available for use by the traffic that matches the rule in the second Committed Time Interval.

After the rule matches the maximum number of Normal Burst Size bytes in the second Committed Time Interval, the rule matches an additional 75,000,000 bits. The software drops all bytes received in the second Committed Time Interval after the Excess Burst Size maximum is reached.

Regardless of the actions for conforming and exceed traffic, the interface drops all traffic that matches a rule after the rule has matched the maximum number bytes for the rule’s Normal Burst Size and Excess Burst Size.

Figure 4.7 shows an example of eight Committed Time Intervals. The software drops traffic in the second and eighth intervals because the interface receives traffic that matches the rule after the rule has already matched the maximum number of bytes for the Normal Burst Size and Excess Burst Size.

In the third and fourth Committed Time Intervals, the rule matches the maximum number of bytes for the Normal Burst Size, and then matches additional bytes. However, the total number of excess bytes that match the rule over these two Committed Time Intervals is not greater than the Excess Burst Size. Therefore, the software does not drop any of the matching traffic.

In the fifth and sixth Committed Time Intervals, the rule matches bytes but does not match even the maximum number of Normal Burst Size bytes in either interval. As a result, the rule does not need to apply the exceed action to any of the traffic that matches the rule in these intervals.

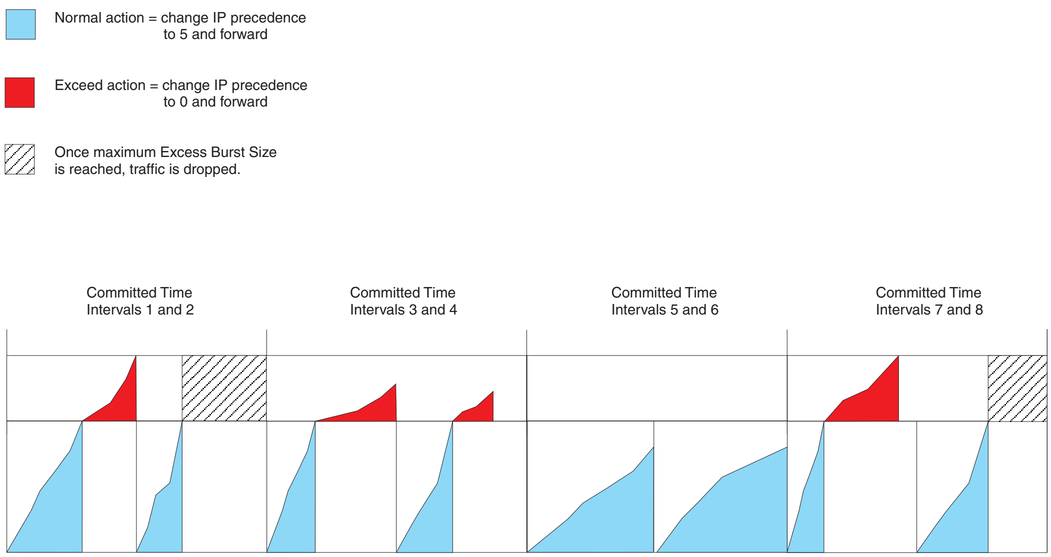


Figure 4.7 Traffic after the Excess Burst Size is reached is always dropped

Committed Time Interval

The Committed Time Interval specifies the granularity of the rate policing. The Committed Time Interval can be from 1/10th second up to one second. The length depends on the ratio of the Average Rate to the Normal Burst Size, parameters you specify when you configure a rate policy rule. The examples in the previous section all use a Committed Time Interval of one second. Since the Normal Burst Size is equal to the Average Rate, the ratio is 1:1. Therefore, the Committed Time Interval is one second.

The one-second interval is the least granular. The 1/10th-second interval is the most granular. To obtain the 1/10th-second interval, specify a Normal Burst Size that is 1/10th the Average Rate.

Configuring Adaptive Rate Limiting

To configure Adaptive Rate Limiting, perform the following steps:

- Characterize the traffic you want to manage. You can apply Adaptive Rate Limiting to any of the following:
    - All traffic (the default)
    - Traffic with certain precedence values sent or received on a specific interface
    - Traffic for specific source or destination IP host or network addresses
    - Traffic for specific TCP/UDP applications
    - Traffic from specific MAC addresses

NOTE: To characterize the traffic, configure ACLs. You can use ACLs for rate policy rules applied to IP interfaces or to virtual interfaces, but not for rate policy rules applied directly to port-based VLANs. When you apply a rate policy rule to a port-based VLAN, the policy applies to all Ethernet traffic.

- Specify how much bandwidth you want to allow the traffic for normal service, and whether you want the device to change the precedence for the traffic before forwarding it.
- For bandwidth above the normal service, specify the action you want the device to take. For example, you can configure the device to drop all traffic that exceeds the normal bandwidth allocation, or change the traffic's precedence or Diffserv control point, and so on.
- Apply the traffic characterization, the bandwidth limits, and the actions to incoming or outgoing traffic on a specific IP interface, virtual interface, or port-based VLAN.

Characterizing the Traffic

You can use the following types of ACLs to characterize traffic. When you configure a rate policy rule on an interface, you can refer to the ACLs. In this case, the rate policy rule applies to the traffic that matches the ACLs.

- Standard IP ACL – Matches packets based on source IP address.
- Extended IP ACL – Matches packets based on source and destination IP address and also based on IP protocol information. If you specify the TCP or UDP IP protocol, you also match packets based on source or destination TCP or UDP application port.
- Rate limit ACL – Matches packets based on source MAC address, IP precedence or Diffserv control points, or a set of IP precedence values.

You can configure a rate policy rule without using an ACL. In this case, the rule applies to all types of Ethernet traffic. In fact, you cannot use ACLs in a rate policy rule you apply to a port-based VLAN. A rate policy rule you apply to a port-based VLAN applies to all types of Ethernet traffic.

To configure the ACLs used by the rate policy in Figure 4.2 on page 4-5, enter the following commands:

```
HP9300(config)# access-list 101 permit tcp any any eq http
HP9300(config)# access-list 102 permit tcp any any eq ftp
HP9300(config)# access-list 103 permit udp any any eq dns
```

These ACLs match on all Ethernet packets whose TCP application port is HTTP, FTP, or DNS.

To configure the rate limit ACL used in Figure 4.3 on page 4-7, enter the following command:

```
HP9300(config)# access-list rate-limit 100 aaaa.bbbb.cccc
```

The configuration in Figure 4.4 on page 4-8 applies a rate policy rule directly to a port-based VLAN and does not use ACLs.

Here is the syntax for standard ACLs.

Syntax: [no] access-list <num> deny | permit <source-ip> | <hostname> <wildcard> [log]

or

Syntax: [no] access-list <num> deny | permit <source-ip>/<mask-bits> | <hostname> [log]

Syntax: [no] access-list <num> deny | permit host <source-ip> | <hostname> [log]

Syntax: [no] access-list <num> deny | permit any [log]

NOTE: The **deny** option is not applicable to rate limiting. Always specify **permit** when configuring an ACL for use in a rate limiting rule.

Here is the syntax for extended ACLs.

Syntax: access-list <num> deny | permit <ip-protocol> <source-ip> | <hostname> <wildcard> [<operator> <source-tcp/udp-port>] <destination-ip> | <hostname> <wildcard> [<operator> <destination-tcp/udp-port>] [precedence <num> | <num>] [tos <name> | <num>] [log]

NOTE: The **deny** option is not applicable to rate limiting. Always specify **permit** when configuring an ACL for use in a rate limiting rule.

Syntax: [no] access-list <num> deny | permit host <ip-protocol> any any [log]

NOTE: For complete syntax descriptions for standard and extended ACLs, see "Using Access Control Lists (ACLs)" on page 3-1.

Here is the syntax for rate limit ACLs.

Syntax: [no] access-list rate-limit <num> <mac-addr> | <precedence> | mask <precedence-mask>

The <num> parameter specifies the ACL number.

The <mac-addr> | <precedence> | **mask** <precedence-mask> parameter specifies a MAC address, an IP precedence, or a mask value representing a set of IP precedence values or a Diffserv control point.

To specify a MAC address, enter the address in the following format: xxxx.xxxx.xxxx.

To specify an IP precedence, specify one of the following:

- **0** – The ACL matches packets that have the routine precedence.
- **1** – The ACL matches packets that have the priority precedence.
- **2** – The ACL matches packets that have the immediate precedence.
- **3** – The ACL matches packets that have the flash precedence.
- **4** – The ACL matches packets that have the flash override precedence.
- **5** – The ACL matches packets that have the critical precedence.
- **6** – The ACL matches packets that have the internetwork control precedence.
- **7** – The ACL matches packets that have the network control precedence.

To specify a mask value for a set of IP precedence values, enter **mask** followed by a two-digit hexadecimal number for the precedence values.

The precedence values are in an 8-bit field in the IP packet header. To calculate the hexadecimal number for a combination of precedence values, write down the values for the entire field to create the binary number for the mask value, then convert the number to hexadecimal. For example, to specify a mask for precedences 2, 4, and 5, write down the following values for the precedence field:

Bit position	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Precedence	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Bit pattern	0	0	1	1	0	1	0	0

Then, reading the digits from right to left, convert the number to hexadecimal. In this case, 00110100 binary becomes 0x34. Enter the mask as **mask 34**.

For simplicity, you can convert the digits in groups of four bits each.

For example, you can convert bits 1 – 4 (binary 0100) to get hexadecimal "4" for the right digit. Then convert bits 5 – 8 (binary 0011) to get hexadecimal "3" for the left digit. The result is "34".

Alternatively, you can enter the entire eight-bit binary number in a calculator, then convert the number to hexadecimal. For example, you can enter the binary number "00110100" and convert it to hexadecimal to get "34". (Without the leading zeros, enter "110100".)

NOTE: The bits appear in this order in the IP precedence field and the software reads them from right to left. The least significant digit is the rightmost digit (bit position 1) and the most significant digit is the leftmost digit (bit position 8).

You also can use the **mask** <precedence-mask> parameter to specify a Diffserv control point. Regardless of whether the mask value you specify represents a set of IP precedences or a Diffserv control point, the software examines the value in the field and responds with the action you specify.

NOTE: Rate limiting for Diffserv is not supported in the current release.

Specifying the Bandwidth Allowances and Applying Rate Policy Rules to an Interface

When you apply a rate policy rule to an interface, you specify the following:

- The amount of the interface's bandwidth you are allowing for traffic that matches the rule
- The actions you want the device to take for traffic that conforms to the rule (is within the Normal Burst Size) and for traffic that exceeds the rule (is within the Excess Burst Size).

You can apply up 20 rate policy rules to an interface for inbound traffic and up to 20 additional rules for outbound traffic. The maximum number of rules for either direction is 20. When you apply more than one rule to an interface, the software interprets the rules in order, beginning with the first rule you apply to the interface and ending with the last rule you apply. When the traffic matches a rule, the software performs the action associated with that rule.

You can apply rate policy rules to the following types of interfaces:

- Physical port
- Trunk group (apply the policy to the trunk group's primary port)
- Virtual interface
- Port-based VLAN

CLI Examples

To specify the values for the rate policies in Figure 4.2 on page 4-5 and apply the policies, enter the following commands:

```
HP9300(config)# interface ethernet 1/1
HP9300(config-if-e1000-1/1)# rate-limit input access-group 101 10000000 125000
187500 conform-action set-prec-transmit 5 exceed-action set-prec-transmit 0
HP9300(config-if-e1000-1/1)# rate-limit input access-group 101 10000000 125000
187500 conform-action set-prec-transmit 5 exceed-action set-prec-transmit 0
HP9300(config-if-e1000-1/1)# rate-limit input access-group 102 10000000 125000
187500 conform-action set-prec-transmit 5 exceed-action drop
HP9300(config-if-e1000-1/1)# rate-limit output access-group 103 1000000 100000
100000 conform-action set-prec-transmit 5 exceed-action drop
HP9300(config-if-e1000-1/1)# rate-limit input 4000000 80000 120000 conform-action
set-prec-transmit 5 exceed-action drop
```

To specify the values for the rate policies in Figure 4.3 on page 4-7 and apply the policies, enter the following commands:

```
HP9300(config)# interface virtual ve2
HP9300(config-ve-2)# rate-limit input access-group ratelimit 100 4000000 320000
400000 conform-action transmit exceed-action drop
```

To specify the values for the rate policies in Figure 4.4 on page 4-8 and apply the policies, enter the following commands:

```
HP9300(config)# vlan 2
HP9300(config-vlan-2)# rate-limit input 10000000 125000 187500 conform-action
set-prec-transmit 5 exceed-action set-prec-transmit 0
```

CLI Syntax

Syntax: [no] rate-limit input | output [access-group <num>] <average-rate> <normal-burst-size> <excess-burst-size> conform-action <action> exceed-action <action>

The **input | output** parameter specifies whether the rule applies to inbound traffic or outbound traffic.

- Specify **input** for inbound traffic.
- Specify **output** for outbound traffic.

The **access-group** <num> parameter specifies an ACL. When you use this parameter, the rule applies only to traffic that matches the specified ACL. Otherwise, the rule applies to all Ethernet traffic that does not match a previous rule on the interface. You can specify the number of a standard ACL, and extended ACL, or a rate limit ACL. If you specify a rate limit ACL, use the parameter **ratelimit** (without a space) in front of the ACL number; for example, **ratelimit 100**.

NOTE: You cannot specify a named ACL.

The <average-rate> parameter specifies the portion, in bits per second (bps) of the interface's total bandwidth you want to allocate to traffic that matches the rule. You can specify a value can from 262144 (256Kbps) up to the maximum line rate of the port. For example, for a 100Mbps port, the maximum value is 100,000,000 (100Mbps).

If the interface is a trunk group, a virtual interface, or a VLAN, you can specify a value up to the maximum combined line rate of all the ports in the interface. For example, if the interface is a trunk group that consists of two one-Gigabit Ethernet ports, then the maximum value for <average-rate> is 2,000,000,000 (two times the maximum for each of the individual Gigabit ports).

The <normal-burst-size> parameter specifies the maximum number of bytes that specific traffic can send on the interface within the Committed Time Interval and still be within that traffic's rate limit. The minimum value is 3277[1] or 1/10th of the Average Rate (whichever is higher), and the maximum value is the Average Rate. The smallest fraction of the Average Rate you can specify is 1/10th.

The <excess-burst-size> parameter specifies the maximum number of additional bytes (bytes over the <normal-burst-size>) that can be transmitted within the Committed Time Interval. The <excess-burst-size> can be a value equal to or greater than the <normal-burst-size> up to the maximum number of bytes the interface can forward within the Committed Time Interval (see "Committed Time Interval" on page 4-9).

The device can take different actions for traffic within the <normal-burst-size> and traffic that falls into the <excess-burst-size>. For example, you can forward all traffic in the <normal-burst-size> and reset the precedence to a lower priority for all <excess-burst-size> traffic, or even just drop that traffic.

NOTE: Do not set the <excess-burst-size> parameter to a value greater than the maximum number of bytes the interface can forward within the Committed Time Interval. Even if the software allows you to specify a higher value, the interface cannot forward more data than its line rate supports.

The **conform-action** <action> parameter specifies the action you want the device to take for traffic that matches the rule and is within the Normal Burst Size. You can specify one of the following actions:

- **transmit** – Send the packet.
- **set-prec-transmit** <new-prec> – Set the IP precedence, then send the packet. You can specify one of the following:
  - **0** – routine precedence
  - **1** – priority precedence
  - **2** – immediate precedence
  - **3** – flash precedence

1.This value comes from dividing the minimum Average Rate (262144 bits) by eight to get 32768 bytes, then dividing 32768 bytes by 10 to get 3276.8, since the smallest fraction of the Average Rate you can specify is 1/10th. The value 3276.8 is then rounded up to 3277.

- **4** – flash override precedence
- **5** – critical precedence
- **6** – internetwork control precedence
- **7** – network control precedence

- **set-prec-continue** <new-prec> – Set the IP precedence to one of the values listed above, then evaluate the traffic based on the next rate policy.
- **drop** – Drop the packet.
- **continue** – Evaluate the traffic based on the next rate policy.

The **exceed-action** <action> parameter specifies the action you want the device to perform for traffic that matches the rule but exceeds the <normal-burst-size> within a given Committed Time Interval. You can specify one of the actions listed above.

Complete CLI Examples

This section lists and explains the CLI commands for implementing the Adaptive Rate Limiting applications in "Examples of Adaptive Rate Limiting Applications" on page 4-5.

Commands for "Adaptive Rate Policies For an Uplink"

To configure the Adaptive Rate Limiting application described in "Adaptive Rate Policies For an Uplink" on page 4-5, enter the following commands.

The first three commands configure extended ACLs to characterize the traffic. ACL 101 is for all web traffic. ACL 102 is for all FTP traffic. ACL 102 is for all DNS traffic. Each of the ACLs matches on any source and destination IP address.

```
HP9300(config)# access-list 101 permit tcp any any eq http
HP9300(config)# access-list 102 permit tcp any any eq ftp
HP9300(config)# access-list 103 permit udp any any eq dns
```

The following command changes the CLI to the configuration level for port 1/1. If the port is the primary port in a trunk group, the rate policy configuration applies to all ports in the trunk group. In this case, port 1/1 is the primary port in a trunk group that also contains port 1/2.

```
HP9300(config)# interface ethernet 1/1
```

The following command configures a rate limit rule that uses ACL 101.

```
HP9300(config-if-e1000-1/1)# rate-limit input access-group 101 10000000 125000
187500 conform-action set-prec-transmit 5 exceed-action set-prec-transmit 0
```

The rule compares all inbound packets on the trunk group to ACL 101. For packets that match the ACL, the rule either sets the IP precedence to 5 (critical) and then sends the packet, or sets the IP precedence to 0 (routine) and sends the packet. The rule sets the precedence to 5 for all packets received up to the maximum Normal Burst Size, 125000 bytes. Once the interface receives this many bytes in the inbound direction that match ACL 101, the device sets the precedence for the next 62500 bytes to the value associated with the Excess Burst Size.

The burst size counters increment for the duration of the Committed Time Interval, then change back to zero for the next Committed Time Interval. The length of the Committed Time Interval is determined by the ratio of the Average Rate to the Normal Burst Size. In this case, the ratio is 10:1, so the Committed Time Interval is 1/10th second long. The counter for the Normal Burst Size accumulates packets for 1/10th second, then returns to zero. The counter for the Excess Burst Size accumulates packets for 2/10ths second, then returns to zero.

The following command configures a rate limit rule that uses ACL 102. This rule also applies to inbound traffic. The action for packets that exceed the Normal Burst Size is different from the action in the rule above. The rule above sets the precedence to 0 in packets received after the maximum number of conforming packets (the number represented by the Normal Burst Size) is received within the Committed Time Interval.

The following rule drops packets received after the maximum number of conforming packets have been received.

```
HP9300(config-if-e1000-1/1)# rate-limit input access-group 102 10000000 125000
```

```
187500 conform-action set-prec-transmit 5 exceed-action drop
```

The following rule applies to traffic that matches ACL 103. Like the previous rule, this rule drops packets received after the maximum number of conforming packets have been received. However, notice that this rule applies to traffic in the outbound direction.

```
HP9300(config-if-e1000-1/1)# rate-limit output access-group 103 1000000 100000
100000 conform-action set-prec-transmit 5 exceed-action drop
```

The following command configures a rule for all Ethernet traffic that does not match one of the ACLs used in the rules above.

```
HP9300(config-if-e1000-1/1)# rate-limit input 4000000 80000 120000 conform-action
set-prec-transmit 5 exceed-action drop
```

When you make configuration changes, make sure you save them to the startup-config file. If the system resets for any reason or you reload the software, the configuration changes you make are reinstated only if they have been saved to the startup-config file. Enter the following command to save configuration changes:

```
HP9300(config-if-e1000-1/1)# write memory
```

You can enter this command from any configuration level of the CLI.

Commands for “Adaptive Rate Policy for a Specific MAC Address”

To configure the Adaptive Rate Limiting application described in “Adaptive Rate Policy for a Specific MAC Address” on page 4-7, enter the following commands.

The following command configures a rate limit ACL to characterize the traffic. In this case, the rate policy is for a specific host, so the rate limit ACL specifies a host MAC address.

```
HP9300(config)# access-list rate-limit 100 aaaa.bbbb.cccc
```

The following command changes the CLI to the configuration level for virtual interface ve2.

```
HP9300(config)# interface virtual ve2
```

The following command configures rule for inbound traffic that matches the rate limit ACL configured above. The rule sends traffic that conforms to the Normal Burst Size and drops traffic received after the maximum number of conforming bytes have been received.

The Average Rate for the rule is 8000000 bps. The Normal Burst Size is 640000 bytes, and the Excess Burst Size is 800000 bytes. Based on the Average Rate and Normal Burst Size values, the Committed Time Interval is 6.4/10ths of a second, or about 2/3 seconds.

```
HP9300(config-ve-2)# rate-limit input access-group ratelimit 100 4000000 320000
400000 conform-action transmit exceed-action drop
```

The following command saves the configuration changes:

```
HP9300(config-ve-2)# write memory
```

Commands for “Adaptive Rate Policy for a Port-Based VLAN”

To configure the Adaptive Rate Limiting application described in “Adaptive Rate Policy for a Port-Based VLAN” on page 4-8, enter the following commands.

The following command changes the CLI to the configuration level for port-based VLAN 2.

```
HP9300(config)# vlan 2
```

The following command configures a rule for all inbound Ethernet traffic on the VLAN’s ports. The rule applies to all Ethernet packets that come into the device on a port in VLAN 2.

```
HP9300(config-vlan-2)# rate-limit input 10000000 125000 187500 conform-action set-
prec-transmit 5 exceed-action set-prec-transmit 0
```

The following command saves the configuration changes:

```
HP9300(config-vlan-2)# write memory
```

Disabling Rate Limiting Exemption for Control Packets

By default, the device does not apply Adaptive Rate Limiting policies to certain types of control packets, but instead always forwards these packets, regardless of the rate limiting policies in effect.

NOTE: This section applies only to Adaptive Rate Limiting. Fixed Rate Limiting drops all packets that exceed the limit, regardless of packet type.

Table 4.2 lists the types of control packets that are exempt from rate limiting by default.

Table 4.2: IP Control Traffic Exempt from Rate Limiting

Traffic Type		IP Address	IP Protocol or Application Port
IP multicast	IP nodes multicast	224.0.0.1	
	IP routers multicast	224.0.0.2	
	IP DVMRP router multicast	224.0.0.4	
	IP OSPF router multicast	224.0.0.5	
	IP OSPF designated router multicast	224.0.0.6	
	IP RIP V.2 router multicast	224.0.0.9	
	IP VRRP multicast	224.0.0.18	
IP unicast	BGP control packet		TCP port 179 (0xB3)
	OSPF control packet		IP protocol type 89 (0x59)
	RIP packet		UDP port 520 (0x0208)

To provide exemption, the CPU examines each packet to determine whether the packet is one of the exempt control types. If your network does not use these control types and you want to reduce CPU utilization, you can disable exemption for the control packets on an interface. To do so, use the following CLI method.

NOTE: If your network uses BGP, OSPF, or RIP and you disable exemption, the rate limiting polices can result in routing protocol traffic being dropped.

To disable rate limiting exemption for control packets on an interface, enter the following command at the CLI configuration level for that interface:

```
HP9300(config-if-e1000-1/1)# rate-limit control-packet no
```

This command disables exemption of all the control packets listed in Table 4.2 on port 1/1.

Syntax: [no] rate-limit control-packet no | yes

To re-enable exemption for the interface, enter the following command:

```
HP9300(config-if-e1000-1/1)# rate-limit control-packet yes
```

Chapter 5
Configuring Spanning Tree Protocol (STP)

The Spanning Tree Protocol (STP) eliminates Layer 2 loops in networks, by selectively blocking some ports and allowing other ports to forward traffic, based on global (bridge) and local (port) parameters you can configure.

This chapter describes how to configure Spanning Tree Protocol (STP) parameters on HP ProCurve switches and routing switches.

This chapter also describes advanced Layer 2 features that enable you to overcome limitations in the standard 802.1d Spanning Tree Protocol (STP). These are the advanced features:

- Fast Port Span
- Fast Uplink Span
- Single-instance STP
- Per VLAN Spanning Tree+ (PVST+) Compatibility

Configuration procedures are provided for the standard STP bridge and port parameters as well as advanced STP parameters.

- To configure standard STP parameters, see "Configuring Standard STP Parameters".
- To configure advanced STP parameters, see "Configuring Advanced Features" on page 5-13.

Configuring Standard STP Parameters

HP ProCurve devices support standard STP as described in the IEEE 802.1D specification. STP is enabled by default on the HP 6208M-SX but is disabled by default on the routing switches.

By default, each port-based VLAN on an HP device runs a separate spanning tree (a separate instance of STP). An HP device has one port-based VLAN (VLAN 1) by default that contains all the device's ports. Thus, by default each HP device has one spanning tree. However, if you configure additional port-based VLANs on an HP device, then each of those VLANs and VLAN 1 all run separate spanning trees.

When you configure a port-based VLAN, that VLAN inherits the STP state of the default port-based VLAN. Thus, if STP is enabled on the default VLAN, STP is also enabled on the new port-based VLAN. You can change the STP state of the VLAN afterwards. Changes to the STP state of the default VLAN do not affect existing VLANs. A change to the STP state affects only the VLANs you create after the change.

STP Parameters and Defaults

Table 5.1 lists the default STP bridge parameters. The bridge parameters affect the entire VLAN (or the entire device, if the only port-based VLAN is the default one, VLAN 1).

Table 5.1: Default STP Bridge Parameters

Parameter	Description	Default and Valid Values
Forward Delay	The period of time a bridge will wait (the listen and learn period) before beginning to forward data packets.	15 seconds Possible values: 4 – 30 seconds
Maximum Age	The interval a bridge will wait for a hello packet from the root bridge before initiating a topology change.	20 seconds Possible values: 6 – 40 seconds
Hello Time	The interval of time between each configuration BPDU sent by the root bridge.	2 seconds Possible values: 1 – 10 seconds
Priority	A parameter used to identify the root bridge in a spanning tree (instance of STP). The bridge with the lowest value has the highest priority and is the root. A higher numerical value means a lower priority; thus, the highest priority is 0.	32768 Possible values: 0 – 65535

Table 5.2 lists the default STP port parameters. The port parameters affect individual ports and are separately configurable on each port.

Table 5.2: Default STP Port Parameters

Parameter	Description	Default and Valid Values
Priority	The preference that STP gives this port relative to other ports for forwarding traffic out of the spanning tree. A higher numerical value means a lower priority; thus, the highest priority is 0.	128 Possible values: 0 – 255
Path Cost	The cost of using the port to reach the root bridge. When selecting among multiple links to the root bridge, STP chooses the link with the lowest path cost and blocks the other paths. Each port type has its own default STP path cost.	10 Mbps – 100 100 Mbps – 19 Gigabit – 4 Possible values are 0 – 65535

Enabling or Disabling the Spanning Tree Protocol (STP)

You can enable or disable STP on the following levels:

- Globally – Affects all ports on the device.
- Port-based VLAN – Affects all ports within the specified port-based VLAN. When you enable or disable STP within a port-based VLAN, the setting overrides the global setting. Thus, you can enable STP for the ports within a port-based VLAN even when STP is globally disabled, or disable the ports within a port-based VLAN when STP is globally enabled.

Enabling or Disabling STP Globally

Use the following methods to enable or disable STP on a device on which you have not configured port-based VLANs.

NOTE: When you configure a VLAN, the VLAN inherits the global STP settings. However, once you begin to define a VLAN, you can no longer configure standard STP parameters globally using the CLI. From that point on, you can configure STP only within individual VLANs.

USING THE CLI

To enable STP for all ports on a device, enter the following command:

```
HP9300(config)# spanning-tree
```

Syntax: [no] spanning-tree

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Select Enable next to Spanning Tree.

   NOTE: For information about the Single and Fast checkboxes, see “Single Spanning Tree” on page 5-17 and “Fast Uplink Span” on page 5-15.

   ---

3. Click Apply to save the changes to the device’s running-config file.
4. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Enabling or Disabling STP in a Port-Based VLAN

Use the following procedure to disable or enable STP on a device on which you have configured a port-based VLAN.

USING THE CLI

To enable STP for all ports in a port-based VLAN, enter commands such as the following:

```
HP9300(config)# vlan 10
HP9300(config-vlan-10)# spanning-tree
```

Syntax: [no] spanning-tree

USING THE WEB MANAGEMENT INTERFACE

You cannot enable or disable STP on individual VLANs using the Web management interface. Use the procedure in “Enabling or Disabling STP Globally” on page 5-3 to enable or disable STP on all the VLANs. If you need STP to be enabled on some VLANs but disabled in other VLANs, use the CLI method above.

Changing STP Bridge and Port Parameters

Table 5.1 on page 5-2 and Table 5.2 on page 5-2 list the default STP parameters. If you need to change the default value for an STP parameter, use the following procedures.

Changing STP Bridge Parameters

To change STP bridge parameters, use either of the following methods.

USING THE CLI

To change a device's STP bridge priority to the highest value to make the device the root bridge, enter the following command:

```
HP9300(config)# spanning-tree priority 0
```

The command in this example changes the priority on a device on which you have not configured port-based VLANs. To configure the same parameters on a port-based VLAN, enter commands such as the following:

```
HP9300(config)# vlan 10
HP9300(config-vlan-10)# spanning-tree priority 0
```

Syntax: [no] spanning-tree [forward-delay <value>] | [hello-time <value>] | [maximum-age <value>] | [priority <value>]

The **forward-delay** <value> parameter specifies the forward delay and can be a value from 4 – 30 seconds. The default is 15 seconds.

NOTE: You can configure a device for faster convergence (including a shorter forward delay) using Fast Span or Fast Uplink Span. See "Configuring Advanced Features" on page 5-13.

The **hello-time** <value> parameter specifies the hello time and can be a value from 1 – 10 seconds. The default is 2 seconds.

NOTE: This parameter applies only when this device or VLAN is the root bridge for its spanning tree.

The **maximum-age** <value> parameter specifies the amount of time the device waits for receipt of a hello packet before initiating a topology change. You can specify from 6 – 40 seconds. The default is 20 seconds.

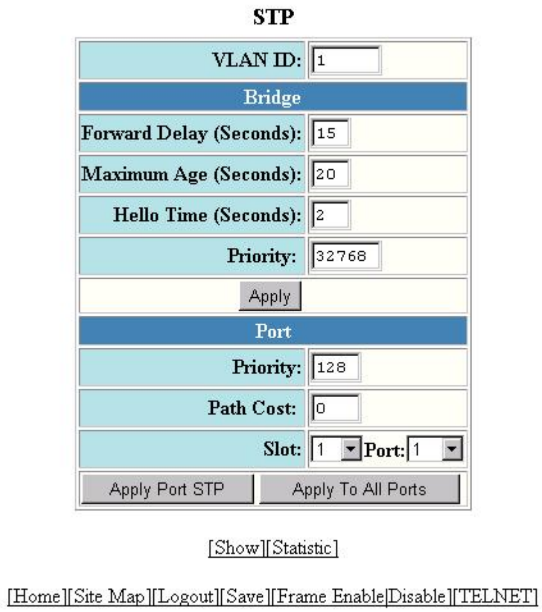
The **priority** <value> parameter specifies the priority and can be a value from 0 – 65535. A higher numerical value means a lower priority. Thus, the highest priority is 0. The default is 32768.

You can specify some or all of these parameters on the same command line. If you specify more than one parameter, you must specify them in the order shown above, from left to right.

USING THE WEB MANAGEMENT INTERFACE

To modify the STP parameters:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the configuration options.
3. Select the STP link to display the STP bridge and port parameters.
4. Click the Modify button in the STP bridge parameters table to display the STP configuration panel, as shown in the following example. If the device has multiple port-based VLANs, select the Modify button next to the VLAN on which you want to change the parameters. A dialog such as the following is displayed.



5. Modify the bridge STP parameters to the values desired.
6. Click Apply to save the changes to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Changing STP Port Parameters

To change STP port parameters, use either of the following methods.

USING THE CLI

To change the path and priority costs for a port, enter commands such as the following:

```
HP9300(config)# vlan 10
HP9300(config-vlan-10)# spanning-tree ethernet 1/5 path-cost 15 priority 64
```

Syntax: spanning-tree ethernet <portnum> path-cost <value> | priority <value>

The **ethernet** <portnum> parameter specifies the interface.

The **path-cost** <value> parameter specifies the port's cost as a path to the spanning tree's root bridge. STP prefers the path with the lowest cost. You can specify a value from 0 – 65535. A higher numerical value means a lower priority; thus, the highest priority is 0.

The default depends on the port type:

- 10 Mbps – 100
- 100 Mbps – 19
- Gigabit – 4

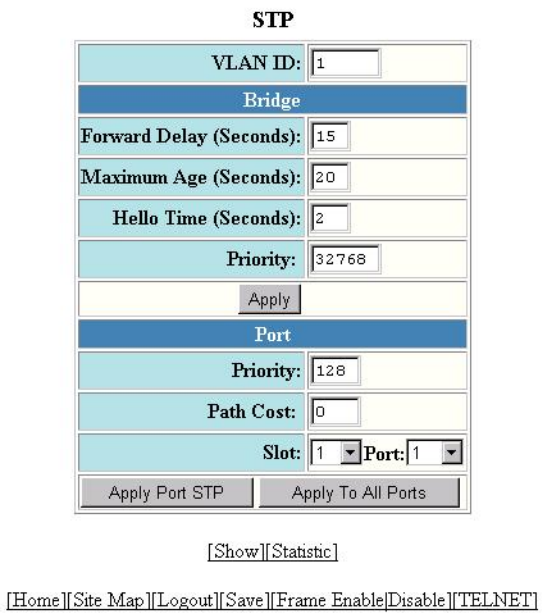
The **priority** <value> parameter specifies the preference that STP gives this port relative to other ports for forwarding traffic out of the spanning tree. You can specify a value from 0 – 255. The default is 128.

USING THE WEB MANAGEMENT INTERFACE

To modify the STP port parameters:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.

2. Click on the plus sign next to Configure in the tree view to display the configuration options.
3. Select the STP link to display the STP bridge and port parameters.
4. Click the Modify button in the STP port parameters table to display the STP configuration panel, as shown in the following example. If the device has multiple port-based VLANs, select the Modify button next to the VLAN on which you want to change the parameters. A dialog such as the following is displayed.



5. Select the port (and slot if applicable) from the Port and Slot pulldown lists.
6. Enter the desired changes to the priority and path cost fields.
7. Click Apply STP Port to apply the changes to only the selected port or select Apply To All Ports to apply the changes to all the ports.

NOTE: If you want to save the priority and path costs of one port to all other ports on the device or within the selected VLAN, you can click the Apply To All Ports button.

---

8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Displaying STP Information

You can display the following STP information:

- All the global and interface STP settings
- STP state information for an individual interface
- STP state information for a port-based VLAN

Displaying STP Information for an Entire Device

To display STP information for an entire device, use either of the following methods.

USING THE CLI

To display STP information, enter the following command at any level of the CLI:

```
HP9300(config)# show span

Global STP Parameters:

VLAN Root             Root Root Prio Max He- Ho- Fwd Last      Chg  Bridge
 ID   ID              Cost Port rity Age llo ld  dly Chang     cnt  Address
                                Hex  sec sec sec sec sec
   1 800000e052a9bb40 0    Root 8000 20  2   2   15  0         6    00e052a9bb40

Port STP Parameters:

VLAN Port  Prio Path State      Fwd    Design Design           Design
 ID  Num   rity Cost            Trans  Cost   Root             Bridge
           Hex
   1 3/1   80   19   ENABLED    2      0      800000e052a9bb40 800000e052a9bb40
   1 3/2   80   0    DISABLED   0      0      0000000000000000 0000000000000000
   1 3/3   80   0    DISABLED   0      0      0000000000000000 0000000000000000
   1 3/4   80   0    DISABLED   0      0      0000000000000000 0000000000000000
   1 3/5   80   0    DISABLED   0      0      0000000000000000 0000000000000000
   1 3/6   80   0    DISABLED   0      0      0000000000000000 0000000000000000
   1 3/7   80   0    DISABLED   0      0      0000000000000000 0000000000000000

   1 3/8   80   0    DISABLED   0      0      0000000000000000 0000000000000000

   1 3/9   80   0    DISABLED   0      0      0000000000000000 0000000000000000

   1 3/10 80    0    DISABLED   0      0      0000000000000000 0000000000000000
```

Syntax: show span [vlan <vlan-id>] | [pvst-mode] | [<num>]

The **vlan** <vlan-id> parameter displays STP information for the specified port-based VLAN.

The **pvst-mode** parameter displays STP information for the device's Per VLAN Spanning Tree (PVST+) compatibility configuration. See "PVST/PVST+ Compatibility" on page 5-20.

The <num> parameter displays only the entries after the number you specify. For example, on a device with three port-based VLANs, if you enter 1, then information for the second and third VLANs is displayed, but information for the first VLAN is not displayed. Information is displayed according to VLAN number, in ascending order. The entry number is not the same as the VLAN number. For example, if you have port-based VLANs 1, 10, and 2024, then the command output has three STP entries. To display information for VLANs 10 and 2024 only, enter **show span 1**.

The **show span** command shows the following information.

Table 5.3: CLI Display of STP Information

This Field...	Displays...
Global STP Parameters	
VLAN ID	The port-based VLAN that contains this spanning tree (instance of STP). VLAN 1 is the default VLAN. If you have not configured port-based VLANs on this device, all STP information is for VLAN 1.
Root ID	The ID assigned by STP to the root bridge for this spanning tree.
Root Cost	The cumulative cost from this bridge to the root bridge. If this device is the root bridge, then the root cost is 0.
Root Port	The port on this device that connects to the root bridge. If this device is the root bridge, then the value is “Root” instead of a port number.
Priority Hex	This device or VLAN’s STP priority. The value is shown in hexadecimal format. **Note**: If you configure this value, specify it in decimal format. See “Changing STP Bridge Parameters” on page 5-4.
Max age sec	The number of seconds this device or VLAN waits for a hello message from the root bridge before deciding the root has become unavailable and performing a reconvergence.
Hello sec	The interval between each configuration BPDU sent by the root bridge.
Hold sec	The minimum number of seconds that must elapse between transmissions of consecutive Configuration BPDUs on a port.
Fwd dly sec	The number of seconds this device or VLAN waits following a topology change and consequent reconvergence.
Last Chang sec	The number of seconds since the last time a topology change occurred.
Chg cnt	The number of times the topology has changed since this device was reloaded.
Bridge Address	The STP address of this device or VLAN. **Note**: If this address is the same as the Root ID, then this device or VLAN is the root bridge for its spanning tree.
Port STP Parameters	
VLAN ID	The VLAN that the port is in.
Port Num	The port number.
Priority Hex	The port’s STP priority, in hexadecimal format. **Note**: If you configure this value, specify it in decimal format. See “Changing STP Port Parameters” on page 5-5.
Path Cost	The port’s STP path cost.

Table 5.3: CLI Display of STP Information (Continued)

This Field...	Displays...
State	The port's STP state. The state can be one of the following: • BLOCKING – STP has blocked Layer 2 traffic on this port to prevent a loop. The device or VLAN can reach the root bridge using another port, whose state is FORWARDING. When a port is in this state, the port does not transmit or receive user frames, but the port does continue to receive STP BPDUs. • DISABLED – The port is not participating in STP. This can occur when the port is disconnected or STP is disabled on the port. • FORWARDING – STP is allowing the port to send and receive frames. • LISTENING – STP is responding to a topology change and this port is listening for a BPDU from neighboring bridge(s) in order to determine the new topology. No user frames are transmitted or received during this state. • LEARNING – The port has passed through the LISTENING state and will change to the BLOCKING or FORWARDING state, depending on the results of STP's reconvergence. The port does not transmit or receive user frames during this state. However, the device can learn the MAC addresses of frames that the port receives during this state and make corresponding entries in the MAC table.
Fwd Trans	The number of times STP has changed the state of this port between BLOCKING and FORWARDING.
Design Cost	The cost to the root bridge as advertised by the designated bridge that is connected to this port. If the designated bridge is the root bridge itself, then the cost is 0. The identity of the designated bridge is shown in the Design Bridge field.
Design Root	The root bridge as recognized on this port. The value is the same as the root bridge ID listed in the Root ID field.
Design Bridge	The designated bridge to which this port is connected. The designated bridge is the device that connects the network segment on the port to the root bridge.

USING THE WEB MANAGEMENT INTERFACE

To display STP information:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to display the monitoring options.
3. Select the STP link to display the STP bridge and port parameters.

Table 5.4: Web Management Display of STP Information

This Field...	Displays...
STP Bridge Parameters (global parameters)	
VLAN ID	The port-based VLAN that contains this spanning tree (instance of STP). VLAN 1 is the default VLAN. If you have not configured port-based VLANs on this device, all STP information is for VLAN 1.
Root ID	The ID assigned by STP to the root bridge for this spanning tree.
Root Cost	The cumulative cost from this bridge to the root bridge. If this device is the root bridge, then the root cost is 0.
Root Port	The port on this device that connects to the root bridge. If this device is the root bridge, then the value is “Root” instead of a port number.
Priority	This device or VLAN’s STP priority. The value is shown in hexadecimal format. **Note**: If you configure this value, specify it in decimal format. See “Changing STP Bridge Parameters” on page 5-4.
Max Age	The number of seconds this device or VLAN waits for a hello message from the root bridge before deciding the root has become unavailable and performing a reconvergence.
Hello Time	The interval between each configuration BPDU sent by the root bridge.
Hold Time	The minimum number of seconds that must elapse between transmissions of consecutive Configuration BPDUs on a port.
Forward Delay	The number of seconds this device or VLAN waits following a topology change and consequent reconvergence.
Topology Last Change	The number of seconds since the last time a topology change occurred.
Topology Change Counter	The number of times the topology has changed since this device was reloaded.
Bridge Address	The STP address of this device or VLAN. **Note**: If this address is the same as the Root ID, then this device or VLAN is the root bridge for its spanning tree.
STP Port Parameters	
VLAN	The VLAN that the port is in.
Port	The port number.
Priority	The port’s STP priority, in hexadecimal format. **Note**: If you configure this value, specify it in decimal format. See “Changing STP Port Parameters” on page 5-5.
Path Cost	The port’s STP path cost.

Table 5.4: Web Management Display of STP Information (Continued)

This Field...	Displays...
State	The port's STP state. The state can be one of the following: • BLOCKING – STP has blocked Layer 2 traffic on this port to prevent a loop. The device or VLAN can reach the root bridge using another port, whose state is FORWARDING. When a port is in this state, the port does not transmit or receive user frames, but the port does continue to receive STP BPDUs. • DISABLED – The port is not participating in STP. This can occur when the port is disconnected or STP is disabled on the port. • FORWARDING – STP is allowing the port to send and receive frames. • LISTENING – STP is responding to a topology change and this port is listening for a BPDU from neighboring bridge(s) in order to determine the new topology. No user frames are transmitted or received during this state. • LEARNING – The port has passed through the LISTENING state and will change to the BLOCKING or FORWARDING state, depending on the results of STP's reconvergence. The port does not transmit or receive user frames during this state. However, the device can learn the MAC addresses of frames that the port receives during this state and make corresponding entries in the MAC table.
Transition	The number of times STP has changed the state of this port between BLOCKING and FORWARDING.
Cost	The cost to the root bridge as advertised by the designated bridge that is connected to this port. If the designated bridge is the root bridge itself, then the cost is 0. The identity of the designated bridge is shown in the Design Bridge field.
Root	The root bridge as recognized on this port. The value is the same as the root bridge ID listed in the Root ID field.
Bridge	The designated bridge to which this port is connected. The designated bridge is the device that connects the network segment on the port to the root bridge.

Displaying STP Information for an Individual Interface

To display STP information for an individual port, you can use the methods in "Displaying STP Information for an Entire Device" on page 5-7. You also can display some STP information for a specific port using either of the following methods.

USING THE CLI

To display information for a specific port, enter a command such as the following at any level of the CLI:

```
HP9300(config)# show interface ethernet 3/11

FastEthernet3/11 is up, line protocol is up
  Hardware is FastEthernet, address is 00e0.52a9.bb49 (bia 00e0.52a9.bb49)
  Configured speed auto, actual 100Mbit, configured duplex fdx, actual fdx
  Member of L2 VLAN ID 1, port is untagged, port state is FORWARDING
```

```
STP configured to ON, priority is level0, flow control enabled
mirror disabled, monitor disabled
Not member of any active trunks
Not member of any configured trunks
No port name
MTU 1500 bytes, encapsulation ethernet
5 minute input rate: 352 bits/sec, 0 packets/sec, 0.00% utilization
5 minute output rate: 0 bits/sec, 0 packets/sec, 0.00% utilization
1238 packets input, 79232 bytes, 0 no buffer
Received 686 broadcasts, 0 runts, 0 giants
0 input errors, 0 CRC, 0 frame, 0 ignored
529 multicast
918 packets output, 63766 bytes, 0 underruns
0 output errors, 0 collisions
```

The STP information is shown in bold type in this example.

Syntax: show interfaces [ethernet <portnum>] | [loopback <num>] | [slot <slot-num>] | [ve <num>] | [brief]

You also can display the STP states of all ports by entering a command such as the following, which uses the **brief** parameter:

```
HP9300(config)# show interface brief

Port  Link State     Dupl Speed Trunk Tag Priori MAC            Name
1/1   Down None      None None  None  No  level0 00e0.52a9.bb00
1/2   Down None      None None  None  No  level0 00e0.52a9.bb01
1/3   Down None      None None  None  No  level0 00e0.52a9.bb02
1/4   Down None      None None  None  No  level0 00e0.52a9.bb03
1/5   Down None      None None  None  No  level0 00e0.52a9.bb04
1/6   Down None      None None  None  No  level0 00e0.52a9.bb05
1/7   Down None      None None  None  No  level0 00e0.52a9.bb06
1/8   Down None      None None  None  No  level0 00e0.52a9.bb07

.
.  some rows omitted for brevity
.
3/10  Down None      None None  None  No  level0 00e0.52a9.bb4a
3/11  Up   Forward   Full 100M  None  No  level0 00e0.52a9.bb49
```

In this example, only one port, 3/11, is forwarding traffic toward the root bridge.

USING THE WEB MANAGEMENT INTERFACE

To display STP information for a specific port, use the same method as the one described in “Displaying STP Information for an Entire Device” on page 5-7:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to display the monitoring options.
3. Select the STP link to display the STP bridge and port parameters.

Displaying the STP State of a Port-Based VLAN

When you display information for a port-based VLAN, that information includes the STP state of the VLAN. Use either of the following methods to display port-based VLAN information.

USING THE CLI

To display information for a port-based VLAN, enter a command such as the following at any level of the CLI:

```
HP9300(config)# show vlan

Total PORT-VLAN entries: 2
```

```
Maximum PORT-VLAN entries: 16

legend: [S=Slot]

PORT-VLAN 1, Name DEFAULT-VLAN, Priority level0, Spanning tree On
 Untagged Ports: (S3)  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16
 Untagged Ports: (S3) 17 18 19 20 21 22 23 24
 Untagged Ports: (S4)  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17
 Untagged Ports: (S4) 18 19 20 21 22 23 24
   Tagged Ports: None
   Uplink Ports: None

PORT-VLAN 2, Name greenwell, Priority level0, Spanning tree Off
 Untagged Ports: (S1)  1  2  3  4  5  6  7  8
 Untagged Ports: (S4)  1
   Tagged Ports: None
   Uplink Ports: None
```

The STP state is shown in bold type in this example.

USING THE WEB MANAGEMENT INTERFACE

To display STP information for a specific VLAN:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view.
3. Select the VLAN link to display the VLAN configuration options.
4. Select the Port link to display configuration information for the device's port-based VLANs. The STP state is shown in the STP column.

Configuring Advanced Features

This section describes how to configure the following features:

- Fast Port Span
- Fast Uplink Span
- Single-instance STP
- Per VLAN Spanning Tree+ (PVST+) Compatibility

Fast Port Span

When STP is running on a device, message forwarding is delayed during the spanning tree recalculation period following a topology change. The STP forward delay parameter specifies the period of time a bridge waits before forwarding data packets. The forward delay controls the listening and learning periods of STP reconvergence. You can configure the forward delay to a value from 4 – 30 seconds. The default is 15 seconds. Thus, using the standard forward delay, convergence requires 30 seconds (15 seconds for listening and an additional 15 seconds for learning) when the default value is used.

This slow convergence is undesirable and unnecessary in some circumstances. The Fast Port Span feature allows certain ports to enter the forwarding state in four seconds. Specifically, Fast Port Span allows faster convergence on ports that are attached to end stations and thus do not present the potential to cause Layer 2 forwarding loops. Because the end stations cannot cause forwarding loops, they can safely go through the STP state changes (blocking to listening to learning to forwarding) more quickly than is allowed by the standard STP convergence time. Fast Port Span performs the convergence on these ports in four seconds (two seconds for listening and two seconds for learning).

In addition, Fast Port Span enhances overall network performance in the following ways:

- Fast Port Span reduces the number of STP topology change notifications on the network. When an end station attached to a Fast Span port comes up or down, the HP device does not generate a topology change notification for the port. In this situation, the notification is unnecessary since a change in the state of the host does not affect the network's topology.
- Fast Port Span eliminates unnecessary MAC cache aging that can be caused by topology change notifications. Bridging devices age out the learned MAC addresses in their MAC caches if the addresses are unrefreshed for a given period of time, sometimes called the MAC aging interval. When STP sends a topology change notification, devices that receive the notification use the value of the STP forward delay to quickly age out their MAC caches. For example, if a device's normal MAC aging interval is 5 minutes, the aging interval changes temporarily to the value of the forward delay (for example, 15 seconds) in response to an STP topology change.

  In normal STP, the accelerated cache aging occurs even when a single host goes up or down. Because Fast Port Span does not send a topology change notification when a host on a Fast Port Span port goes up or down, the unnecessary cache aging that can occur in these circumstances under normal STP is eliminated.

Fast Port Span is a system-wide parameter and is enabled by default. Thus, when you boot a device with software release 06.6.05 or later, all the ports that are attached only to end stations run Fast Port Span. For ports that are not eligible for Fast Port Span, such as ports connected to other networking devices, the device automatically uses the normal STP settings. If a port matches any of the following criteria, the port is ineligible for Fast Port Span and uses normal STP instead:

- The port is 802.1q tagged
- The port is a member of a trunk group
- The port has learned more than one active MAC address
- An STP Configuration BPDU has been received on the port, thus indicating the presence of another bridge on the port.

You also can explicitly exclude individual ports from Fast Port Span if needed. For example, if the only uplink ports for a wiring closet switch are Gigabit ports, you can exclude the ports from Fast Port Span.

Disabling and Re-enabling Fast Port Span

Fast Port Span is a system-wide parameter and is enabled by default. Thus all ports that are eligible for Fast Port Span use it.

To disable or re-enable Fast Port Span, use one of the following methods.

USING THE CLI

To disable Fast Port Span, enter the following commands:

```
HP9300(config)# no fast port-span
HP9300(config)# write memory
```

Syntax: [no] fast port-span

NOTE: The **fast port-span** command has additional parameters that let you exclude specific ports. These parameters are shown in the following section.

To re-enable Fast Port Span, enter the following commands:

```
HP9300(config)# fast port-span
HP9300(config)# write memory
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click the Fast checkbox next to Spanning Tree to remove the checkmark from the box.
3. Click Apply to apply the change to the device's running-config.

4. Select the Save link at the bottom of the panel. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Excluding Specific Ports from Fast Port Span

You can exclude individual ports from Fast Port Span while leaving Fast Port Span enabled globally. To do so, use one of the following methods.

USING THE CLI

To exclude a port from Fast Port Span, enter commands such as the following:

```
HP9300(config)# fast port-span exclude ethernet 1/1
HP9300(config)# write memory
```

To exclude a set of ports from Fast Port Span, enter commands such as the following:

```
HP9300(config)# fast port-span exclude ethernet 1/1 ethernet 2/1 ethernet 3/2
HP9300(config)# write memory
```

To exclude a contiguous (unbroken) range of ports from Fast Span, enter commands such as the following:

```
HP9300(config)# fast port-span exclude ethernet 1/1 to 1/24
HP9300(config)# write memory
```

Syntax: [no] fast port-span [exclude ethernet <portnum> [ethernet <portnum>… | to <portnum>]]

To re-enable Fast Port Span on a port, enter a command such as the following:

```
HP9300(config)# no fast port-span exclude ethernet 1/1
HP9300(config)# write memory
```

This command re-enables Fast Port Span on port 1/1 only and does not re-enable Fast Port Span on other excluded ports. You also can re-enable Fast Port Span on a list or range of ports using the syntax shown above this example.

To re-enable Fast Port Span on all excluded ports, disable and then re-enable Fast Port Span by entering the following commands:

```
HP9300(config)# no fast port-span
HP9300(config)# fast port-span
HP9300(config)# write memory
```

Disabling and then re-enabling Fast Port Span clears the exclude settings and thus enables Fast Port Span on all eligible ports. To make sure Fast Port Span remains enabled on the ports following a system reset, save the configuration changes to the startup-config file after you re-enable Fast Port Span. Otherwise, when the system resets, those ports will again be excluded from Fast Port Span.

USING THE WEB MANAGEMENT INTERFACE

You cannot exclude individual ports from Fast Span using the Web management interface.

Fast Uplink Span

The Fast Port Span feature described in the previous section enhances STP performance for end stations. The Fast Uplink feature enhances STP performance for wiring closet switches with redundant uplinks. Using the default value for the standard STP forward delay, convergence following a transition from an active link to a redundant link can take 30 seconds (15 seconds for listening and an additional 15 seconds for learning).

You can use the Fast Uplink feature on an HP device deployed as a wiring closet switch to decrease the convergence time for the uplink ports to another device to just four seconds (two seconds for listening and two seconds for learning). The wiring closet switch must be an HP device but the device at the other end of the link can be an HP device or another vendor's switch. Configuration of the Fast Uplink Span feature takes place entirely on the HP device.

To configure the Fast Uplink Span feature, specify a group of ports that have redundant uplinks on the wiring closet switch (HP device) as members of a Fast Uplink Group. If the active link becomes unavailable, the Fast Uplink Span feature transitions the forwarding to one of the other ports in four seconds. You can configure one

Fast Uplink Span group on the device. All Fast Uplink Span ports are members of the same Fast Uplink Span group.

NOTE: To avoid the potential for temporary bridging loops, Hewlett-Packard recommends that you use the Fast Uplink feature only for wiring closet switches (switches at the edge of the network cloud). In addition, enable the feature only on a group of ports intended for redundancy, so that at any given time only one of the ports is expected to be in the forwarding state.

NOTE: When the wiring closet switch (HP device) first comes up or when STP is first enabled, the uplink ports still must go through the standard STP state transition without any acceleration. This behavior guards against temporary routing loops as the switch tries to determine the states for all the ports. Fast Uplink Span acceleration applies only when a working uplink becomes unavailable.

Fast Uplink Span Rules for Trunk Groups

If you add a port to a Fast Uplink Span group that is a member of a trunk group, the following rules apply:

- If you add the primary port of a trunk group to the Fast Uplink Span group, all other ports in the trunk group are automatically included in the group. Similarly, if you remove the primary port in a trunk group from the Fast Uplink Span group, the other ports in the trunk group are automatically removed from the Fast Uplink Span group.
- You cannot add a subset of the ports in a trunk group to the Fast Uplink Span group. All ports in a trunk group have the same Fast Uplink Span property, as they do for other port properties.
- If the working trunk group is partially down but not completely down, no switch-over to the backup occurs. This behavior is the same as in the standard STP feature.
- If the working trunk group is completely down, a backup trunk group can go through an accelerated transition only if the following are true:
    - The trunk group is included in the fast uplink group.
    - All other ports except those in this trunk group are either disabled or blocked. The accelerated transition applies to all ports in this trunk group.
- When the original working trunk group comes back (partially or fully), the transition back to the original topology is accelerated if the conditions listed above are met.

Configuring a Fast Uplink Port Group

To enable Fast Uplink, use one of the following methods.

USING THE CLI

To configure a group of ports for Fast Uplink Span, enter the following commands:

```
HP9300(config)# fast uplink-span ethernet 4/1 to 4/4
HP9300(config)# write memory
```

Syntax: [no] fast uplink-span [ethernet <portnum> [ethernet <portnum>… | to <portnum>]]

This example configures four ports, 4/1 – 4/4, as a Fast Uplink Span group. In this example, all four ports are connected to a wiring closet switch. Only one of the links is expected to be active at any time. The other links are redundant. For example, if the link on port 4/1 is the active link on the wiring closet switch but becomes unavailable, one of the other links takes over. Because the ports are configured in a Fast Uplink Span group, the STP convergence takes about four seconds instead of taking 30 seconds or longer using the standard STP forward delay.

If you add a port that is the primary port of a trunk group, all ports in the trunk group become members of the Fast Uplink Span group.

You can add ports to a Fast Uplink Span group by entering the **fast uplink-span** command additional times with additional ports. The device can have only one Fast Uplink Span group, so all the ports you identify as Fast Uplink Span ports are members of the same group.

To remove a Fast Uplink Span group or to remove individual ports from a group, use "no" in front of the appropriate **fast uplink-span** command. For example, to remove ports 4/3 and 4/4 from the Fast Uplink Span group configured above, enter the following commands:

```
HP9300(config)# no fast uplink-span ethernet 4/3 to 4/4
HP9300(config)# write memory
```

If you delete a port that is the primary port of a trunk group, all ports in the trunk group are removed from the Fast Uplink Span group.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure the Fast Uplink Span feature using the Web management interface.

Single Spanning Tree

In software releases earlier than 05.2.16, each port-based VLAN runs a separate spanning tree, which you can enable or disable on an individual VLAN basis. This is still the default behavior in software release 06.6.*X* and later. However, this software release enhances HP's STP support by enabling you to configure a single instance of the Spanning Tree Protocol (STP) to run on all the port-based VLANs on a device.

The single STP feature is especially useful for connecting an HP device to other devices that run a single spanning tree in accordance with the 802.1q specification.

Single-instance STP uses the same parameters, with the same value ranges and defaults, as the default STP on HP devices (multiple-instance STP).

STP Defaults

STP is enabled by default on switches and disabled by default on routing switches. On switches and routing switches, each port-based VLAN runs a separate instance of STP by default. Thus, on devices that have multiple port-based VLANs, each VLAN has its own spanning tree domain. In addition, the STP state of each port-based VLAN is independent of the STP states of other VLANs. You can have STP enabled on port-based VLAN 10, but disabled on port-based VLANs 20 and 30, and so on.

When you configure a port-based VLAN, that VLAN inherits the STP state of the default port-based VLAN. Thus, if STP is enabled on the default VLAN, STP is also enabled on the new port-based VLAN. You can change the STP state of the VLAN afterwards. Changes to the STP state of the default VLAN do not affect existing VLANs. A change to the STP state affects only the VLANs you create after the change.

Single STP and Existing Port-Based VLANs

When you enable single STP, all the ports on the device become members of a single spanning tree domain. Thus, the ports share a single BPDU broadcast domain. The HP device places all the ports in a non-configurable VLAN, 4094, to implement the single STP domain. However, this VLAN does not affect port membership in the port-based VLANs you have configured. Other broadcast traffic is still contained within the individual port-based VLANs. Therefore, you can use single STP while still using your existing VLAN configurations without changing your network. In addition, single STP does not affect 802.1q tagging. Tagged and untagged ports alike can be members of the single spanning tree domain.

NOTE: When single STP is enabled, the BPDUs on tagged ports go out untagged.

NOTE: If STP is disabled on a VLAN, you must enable STP on the VLAN before enabling single STP.

Spanning Tree Parameters

The STP parameters behave the same and have the same defaults and possible values whether you use single STP or you use the default configuration of a separate spanning tree for each port-based VLAN (multiple-instance STP).

You can configure the following parameters on the global level. The parameters apply to all ports.

- Forward Delay – The period of time a bridge will wait (the listen and learn period) before forwarding data packets. Possible values: 4 – 30 seconds. Default is 15.

- Maximum Age – The interval a bridge will wait for receipt of a hello packet before initiating a topology change. Possible values: 6 – 40 seconds. Default is 20.
- Hello Time – The interval of time between each configuration BPDU sent by the root bridge. Possible values: 1 – 10 seconds. Default is 2.
- Priority – A parameter used to identify the root bridge in a network. The bridge with the lowest value has the highest priority and is the root. Possible values: 0 – 65,535. Default is 32,768.

You can apply the following parameters on an individual port level.

- Port Priority – This parameter can be used to assign a higher (or lower) priority to a port. In the event that traffic is re-routed, this parameter gives the port forwarding preference over lower priority ports within a VLAN or on the switch or routing switch (when no VLANs are configured for the system). Ports are re-routed based on their priority. The highest value is routed first. Possible values: 0 – 255. Default is 128. This value overrides the system-wide STP priority.
- Path Cost – This parameter can be used to assign a higher or lower path cost to a port. This value can be used to bias traffic toward or away from a certain path during periods of rerouting. For example, if you wish to bias traffic away from a certain port, assign it a higher value than other ports within the VLAN or all other ports (when VLANs are not active on the switch or routing switch). Possible values are 0 – 65,535 and the default values are 1000/port speed for half-duplex ports and (1000/port speed)/2 for full-duplex ports.

Enabling Single STP

To enable single STP, use one of the following methods.

NOTE: If the device has only one port-based VLAN (the default VLAN), then the device is already running a single instance of STP. In this case, you do not need to enable single STP. You need to enable single STP only if the device contains more than one port-based VLAN and you want all the ports to be in the same STP broadcast domain.

NOTE: If STP is disabled on a VLAN, you must enable STP on the VLAN before enabling single STP.

USING THE CLI

To configure the HP device to run a single spanning tree, enter the following command at the global CONFIG level.

```
HP9300(config) spanning-tree single
```

Here is the syntax for the global STP parameters.

Syntax: [no] spanning-tree single [forward-delay <value>]
[hello-time <value>] | [maximum-age <time>] | [priority <value>]

Here is the syntax for the STP port parameters.

Syntax: [no] spanning-tree single [ethernet <portnum> path-cost <value> | priority <value>]

NOTE: Both commands listed above are entered at the global CONFIG level.

NOTE: If the device has only one port-based VLAN, the CLI command for enabling single-instance STP is not listed in the CLI. The command is listed only if you have configured a port-based VLAN.

To change a global STP parameter, enter a command such as the following at the global CONFIG level:

```
HP9300(config) spanning-tree single priority 2
```

This command changes the STP priority for all ports to 2.

To change an STP parameter for a specific port, enter commands such as the following:

```
HP9300(config) spanning-tree single ethernet 1/1 priority 10
```

The commands shown above override the global setting for the STP priority and set the priority to 10 for port 1/1.

To verify that single STP is in effect, enter the following command at any level of the CLI:

```
HP9300(config) show span
```

Syntax: show span [vlan <vlan-id>]

Here is an example of the information displayed by this command. Notice that no VLAN IDs are listed in the VLAN ID column. For STP, all ports are members of VLAN 4094, the single STP VLAN. When you enable single STP, all the ports in the single spanning tree, regardless of other VLAN membership, are configured as members of port-based VLAN 4094. This VLAN is used to implement the single spanning tree. VLAN 4094 is used only by single spanning tree. A port can be a member of VLAN 4094 and another port-based VLAN at the same time without being tagged. All ports in VLAN 4094 share a common STP domain, but for all other traffic, the ports remain within the separate Layer 2 broadcast domains established by the port-based VLANs.

```
HP9300(config)# show span
Global STP Parameters:

VLAN Root             Root Root Prio Max He- Ho- Fwd Last      Chg  Bridge
 ID   ID              Cost Port rity Age llo ld  dly Chang     cnt  Address
                                Hex  sec sec sec sec sec
     800000e052f04f00 0    Root 8000 20  2   2   15  0         0    00e052f04f00

Port STP Parameters:

VLAN Port Prio Path State      Fwd    Design Design           Design
 ID  Num  rity Cost            Trans  Cost   Root             Bridge
          Hex
     1/1  80   0    DISABLED   0      0      0000000000000000 0000000000000000
     1/2  80   0    DISABLED   0      0      0000000000000000 0000000000000000
     1/3  80   0    DISABLED   0      0      0000000000000000 0000000000000000
     1/4  80   0    DISABLED   0      0      0000000000000000 0000000000000000
.
.   some lines omitted for brevity
.
```

To display VLAN information, including the STP state of each VLAN, enter the following command at any CLI level:

```
HP9300(config)# show vlan
```

Syntax: show vlan [<vlan-id> | ethernet <portnum>]

```
HP9300(config)# show vlan

Total PORT-VLAN entries: 3
Maximum PORT-VLAN entries: 8
legend: [S=Slot]
PORT-VLAN 1, Name DEFAULT-VLAN, Priority level0, in single spanning tree domain
 Untagged Ports: (S1)  1  2  3  4  5  6  7  8
 Untagged Ports: (S2)  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16
 Untagged Ports: (S2) 17 18 19 20 21 22 23 24
 Untagged Ports: (S4)  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16
 Untagged Ports: (S4) 17 18 19 20 21 22 23 24
 Untagged Ports: (S6)  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16
 Untagged Ports: (S6) 17 18 19 20 21 22 23 24
   Tagged Ports: None

SINGLE-SPANNING-TREE-VLAN, Name Single-spanning-tree-vlan, Priority level0, in
single spanning tree domain
 Untagged Ports: (S1)  1  2  3  4  5  6  7  8
 Untagged Ports: (S2)  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16
 Untagged Ports: (S2) 17 18 19 20 21 22 23 24
 Untagged Ports: (S4)  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16
```

```
 Untagged Ports: (S4) 17 18 19 20 21 22 23 24
 Untagged Ports: (S6)  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16
 Untagged Ports: (S6) 17 18 19 20 21 22 23 24
   Tagged Ports: None
```

This example shows information for port-based VLAN 1, which is the default VLAN. Notice that a message indicates that the VLAN is in the single STP domain. Also notice that the SINGLE-SPANNING-TREE-VLAN contains all the ports in the device.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the Single checkbox next to Spanning Tree to place a checkmark in the box.
3. Click Apply to apply the change to the device's running-config file.
4. Select the Save link at the bottom of the panel. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

PVST/PVST+ Compatibility

HP devices that are configured to support a separate spanning tree in each port-based VLAN can interoperate with Cisco devices that are running Per VLAN Spanning Tree (PVST) or PVST+, Cisco proprietary STP implementations that support separate spanning trees in each port-based VLAN.

An HP device configured to run a separate spanning tree in each port-based VLAN automatically enables PVST/PVST+ support on a port if that port receives an STP BPDU with PVST/PVST+ format. You also can enable PVST/PVST+ support statically as well as display PVST/PVST+ information for each port.

The information in this section is for reference. If you are running PVST/PVST+ on the Cisco devices and the default support for separate spanning trees in each VLAN on the HP devices, then no configuration is necessary for the devices to share spanning tree information.

NOTE: If you plan to use the PVST/PVST+ support, do not use VLAN 1. PVST+ uses VLAN 1 as a single STP broadcast domain and thus uses a different BPDU format than for other VLANs.

PVST

Each spanning tree (that is, each instance of STP) has one device called the root bridge. The root bridge is the control point for the spanning tree, and sends STP status and topology change information to the other devices in the spanning tree by sending BPDUs to the other devices. The other devices forward the BPDUs as needed.

The format of an STP BPDU differs depending on whether it is a Cisco PVST BPDU or an HP BPDU. HP and Cisco devices also can support single STP BPDUs, which use another format.

- An HP device configured with a separate spanning tree in each VLAN sends BPDUs in standard IEEE 802.1D format, but includes a proprietary four-byte tag. The tag identifies the VLAN the BPDU is for.
- A Cisco device configured for PVST sends the BPDUs to multicast MAC address 01-00-0C-CC-CC-CD. If the device is configured for PVST+, then the device sends BPDUs for all VLANs except VLAN 1 to 01-00-0C-CC-CC-CD. The device sends BPDUs in VLAN 1 to 01-80-C2-00-00-00, the single STP address (see below and "PVST+").
- An HP device configured for single STP (IEEE 802.1Q) sends untagged BPDUs to the well-known STP MAC address 01-80-C2-00-00-00.

NOTE: Cisco devices can be configured to interoperate with devices that support IEEE 802.1Q single STP, but the devices cannot be configured to run single STP.

HP's PVST support enables HP and Cisco devices that have separate spanning trees in each VLAN to interoperate. The HP PVST support is automatically enabled when a port receives a PVST BPDU and does not require configuration on the HP or Cisco device.

When PVST is enabled on an HP port, that port sends BPDUs in PVST format instead of HP's spanning tree format.

PVST+

HP devices and Cisco devices support separate spanning trees on an individual port-based VLAN basis. However, until the IEEE standard for multiple spanning trees is finalized, vendors are using different methods to support multiple spanning trees within their own products. PVST+ is an extension to PVST that enables a Cisco device to interoperate with other devices that are running a single spanning tree (IEEE 802.1Q) while still running a separate spanning tree in each VLAN.

PVST+ uses 802.1Q single STP BPDUs on VLAN 1 and PVST BPDUs (which have a proprietary format) for other VLANs. In this case, the Cisco device uses devices running 802.1Q as tunnels for PVST (non-802.1Q) traffic. The 802.1Q single STP BPDUs are addressed to the well-known STP MAC address 01-80-C2-00-00-00. The PVST BPDUs for the other VLANs are addressed to multicast address 01-00-0C-CC-CC-CD.

The PVST+ method can require manual configuration of STP parameters on the 802.1Q devices to ensure that traffic for the PVST VLANs is not blocked. In addition, the opportunities to adjust STP parameters to load balance traffic on a VLAN basis are limited when using PVST+.

Using HP Single STP with Cisco PVST+

Since HP's single STP feature complies with IEEE 802.1Q (the single STP specification), you also can use an HP device running single STP to interoperate with a Cisco device running PVST+. When you enable single STP on an HP device, the PVST compatibility feature is not enabled, even if a port receives a PVST BPDU.

Enabling PVST/PVST+ Statically

PVST/PVST+ support is automatically enabled on a port if the port receives a BPDU in PVST/PVST+ format. However, you can statically enable PVST/PVST+ support on a port if desired. In this case, the support is enabled immediately and support for HP tagged BPDUs is disabled at the same time. To enable the PVST/PVST+ support, use the following CLI method.

NOTE: When PVST/PVST+ support is enabled on a port, support for HP BPDUs is disabled.

USING THE CLI

To enable PVST/PVST+ support on a port, enter commands such as the following:

```
HP9300(config)# interface ethernet 1/1
HP9300(config-if-1/1)# pvst-mode
```

Syntax: [no] pvst-mode

NOTE: If you disable PVST/PVST+ support, the software still automatically enables PVST/PVST+ support if the port receives an STP BPDU with PVST/PVST+ format.

USING THE WEB MANAGEMENT INTERFACE

You cannot enable PVST support using the Web management interface.

Displaying PVST Information

To display PVST information, use the following CLI method.

USING THE CLI

To display PVST information for ports on an HP device, enter the following command at any level of the CLI:

```
HP 9304M or HP 9308M(config)# show span pvst-mode

VLAN   Port   PVST   PVST
 ID    Num.   Cfg.   On(by cfg. or detect)
 200   10      0      1
 200   11      1      1
```

This example shows that for VLAN 200, PVST support is statically enabled on port 11. PVST is not statically enabled on Port 10, but because port 10 received an incoming PVST BPDU on its interface, the port converted to using PVST mode.

Syntax: show span pvst-mode

The **show span pvst-mode** command displays the following information.

Table 5.5: CLI Display of PVST Information

This Field...	Displays...
VLAN ID	The VLAN to which the PVST/PVST+ information applies.
Port Num.	The HP port number.
PVST cfg.	Whether PVST support is statically enabled on the port. The value can be one of the following: • 0 – The support has not been statically enabled. • 1 – The support has been statically enabled.
PVST on(by cfg. or detect)	Whether PVST/PVST+ support is active on the port. The value can be one of the following: • 0 – PVST/PVST+ support is not enabled. • 1 – PVST/PVST+ support is enabled, either because you statically enabled the support or because the port received an STP BPDU with PVST/PVST+ format.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PVST information using the Web management interface.

Chapter 6
Configuring IP

This chapter describes the Internet Protocol (IP) parameters on HP ProCurve routing switches and switches and how to configure them. After you add IP addresses and configure other IP parameters, see the following chapters for configuration information for the IP routing protocols:

- "Configuring RIP" on page 7-1
- "Configuring OSPF" on page 8-1
- "Configuring BGP4" on page 10-1

To configure and monitor IP, see the following sections:

- "Basic IP Parameters and Defaults – Routing Switches" on page 6-9
- "Basic IP Parameters and Defaults – HP 6208M-SX" on page 6-16
- "Configuring IP Parameters – Routing Switches" on page 6-18
- "Configuring IP Parameters – HP 6208M-SX" on page 6-73
- "Displaying IP Configuration Information and Statistics" on page 6-80

Basic Configuration

IP is enabled by default. Basic configuration consists of adding IP addresses and, for routing switches, enabling a route exchange protocol, such as Routing Information Protocol (RIP).

- If you are configuring a routing switch, see "Configuring IP Addresses" on page 6-18 to add IP addresses, then see one or more of the following to enable and configure the route exchange protocols:
  - "Configuring RIP" on page 7-1
  - "Configuring OSPF" on page 8-1
  - "Configuring BGP4" on page 10-1
- If you are configuring a switch, see "Configuring the Management IP Address and Specifying the Default Gateway" on page 6-73 to add an IP address for management access through the network and to specify the default gateway.

The rest of this chapter describes IP and how to configure it in more detail. Use the information in this chapter if you need to change some of the IP parameters from their default values or you want to view configuration information or statistics.

Overview

The HP Procurve HP 6208M-SX switch and HP 9304M, HP 9308M, and HP 6308M-SX routing switches support Internet Protocol (IP) version 4. IP support on the HP 6208M-SX consists of basic services to support management access and access to a default gateway. IP support on the routing switches includes all of the following, in addition to a highly configurable implementation of basic IP services including Address Resolution Protocol (ARP), ICMP Router Discovery Protocol (IRDP), and Reverse ARP (RARP):

- Route exchange protocols
  - Routing Information Protocol (RIP)
  - Open Shortest Path First (OSPF)
  - Border Gateway Protocol version 4 (BGP4)
- Multicast protocols
  - Internet Group Membership Protocol (IGMP)
  - Protocol Independent Multicast Dense (PIM-DM)
  - Protocol Independent Multicast Sparse (PIM-SM)
  - Distance Vector Multicast Routing Protocol (DVMRP)
- Router redundancy protocols
  - Virtual Router Redundancy Protocol Extended (VRRPE)
  - Virtual Router Redundancy Protocol (VRRP)
  - Standby Router Protocol (SRP)

IP Interfaces

HP ProCurve devices allow you to configure IP addresses. On the routing switches, IP addresses are associated with individual interfaces. On the HP 6208M-SX, a single IP address serves as the management access address for the entire device.

All HP ProCurve devices support configuration and display of IP address in classical sub-net format (example: 192.168.1.1 255.255.255.0) and Classless Interdomain Routing (CIDR) format (example: 192.168.1.1/24). You can use either format when configuring IP address information. IP addresses are displayed in classical sub-net format by default but you can change the display format to CIDR. See “Changing the Network Mask Display to Prefix Format” on page 6-80.

Routing Switches

HP ProCurve routing switches allow you to configure IP addresses on the following types of interfaces:

- Ethernet ports
- Virtual routing interfaces (used by VLANs to route among one another)
- Loopback interfaces

Each IP address on a routing switch must be in a different sub-net. You can have only one interface that is in a given sub-net. For example, you can configure IP addresses 192.168.1.1/24 and 192.168.2.1/24 on the same routing switch, but you cannot configure 192.168.1.1/24 and 192.168.1.2/24 on the same routing switch.

You can configure multiple IP addresses on the same interface.

The number of IP addresses you can configure on an individual interface depends on the routing switch model. To display the maximum number of IP addresses and other system parameters you can configure on a routing switch, see the “Configuring Basic Features” chapter of the *Installation and Getting Started Guide*.

You can use any of the IP addresses you configure on the routing switch for Telnet, Web management, or SNMP access.

The HP 6208M-SX Switch

You can configure an IP address on the HP 6208M-SX for management access to the switch. An IP address is required for Telnet access, Web management access, and SNMP access.

You also can specify the default gateway for forwarding traffic to other sub-nets.

IP Packet Flow Through a Routing Switch

Figure 6.1 shows how an IP packet moves through an HP routing switch.

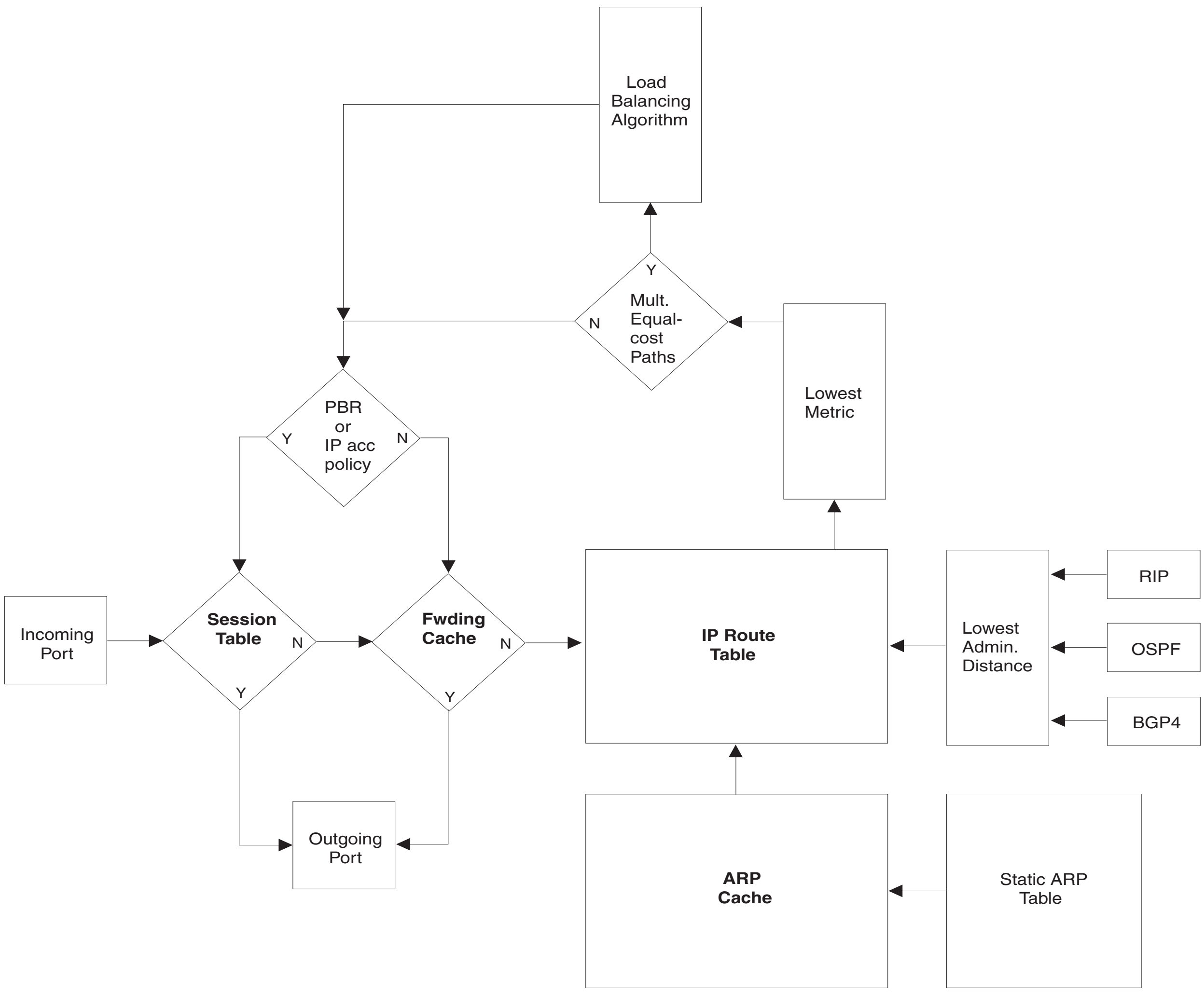


Figure 6.1 IP Packet flow through an HP routing switch

Figure 6.1 shows the following packet flow:

1. When the routing switch receives an IP packet, the routing switch checks for filters on the receiving interface.[1] If a deny filter on the interface denies the packet, the routing switch discards the packet and performs no further processing, except generating a Syslog entry and SNMP message, if logging is enabled for the filter.
2. If the packet is not denied at the incoming interface, the routing switch looks in the session table for an entry that has the same source IP address and TCP or UDP port as the packet. If the session table contains a matching entry, the routing switch immediately forwards the packet, by addressing it to the destination IP

1.The filter can be an Access Control List (ACL) or an IP access policy.

address and TCP or UDP port listed in the session table entry and sending the packet to a queue on the outgoing port(s) listed in the session table. The routing switch selects the queue based on the Quality of Service (QoS) level associated with the session table entry.

3. If the session table does not contain an entry that matches the packet's source address and TCP or UDP port, the routing switch looks in the IP forwarding cache for an entry that matches the packet's destination IP address. If the forwarding cache contains a matching entry, the routing switch forwards the packet to the IP address in the entry. The routing switch sends the packet to a queue on the outgoing port(s) listed in the forwarding cache. The routing switch selects the queue based on the Quality of Service (QoS) level associated with the forwarding cache entry.

4. If the IP forwarding cache does not have an entry for the packet, the routing switch checks the IP route table for a route to the packet's destination. If the IP route table has a route, the routing switch makes an entry in the session table or the forwarding cache, and sends the route to a queue on the outgoing port(s).

   - If the running-config contains a Policy-Based Routing (PBR) definition or an IP access policy for the packet, the software makes an entry in the session table. The routing switch uses the new session table entry to forward subsequent packets from the same source to the same destination.

   - If the running-config does not contain a PBR definition or an IP access policy for the packet, the software creates a new entry in the forwarding cache. The routing switch uses the new cache entry to forward subsequent packets to the same destination.

The following sections describe the IP tables and caches:

- ARP cache and static ARP table
- IP route table
- IP forwarding cache
- IP session table

The software enables you to display these tables. You also can change the capacity of the tables on an individual basis if needed by changing the memory allocation for the table.

ARP Cache and Static ARP Table

The ARP cache contains entries that map IP addresses to MAC addresses. Generally, the entries are for devices that are directly attached to the routing switch.

An exception is an ARP entry for an interface-based static IP route that goes to a destination that is one or more router hops away. For this type of entry, the MAC address is either the destination device's MAC address or the MAC address of the router interface that answered an ARP request on behalf of the device, using proxy ARP.

ARP Cache

The ARP cache can contain dynamic (learned) entries and static (user-configured) entries. The software places a dynamic entry in the ARP cache when the routing switch learns a device's MAC address from an ARP request or ARP reply from the device.

The software can learn an entry when the switch or routing switch receives an ARP request from another IP forwarding device or an ARP reply. Here is an example of a dynamic entry:

```
     IP Address          MAC Address         Type        Age      Port
1     207.95.6.102        0800.5afc.ea21      Dynamic     0          6
```

Each entry contains the destination device's IP address and MAC address.

Static ARP Table

In addition to the ARP cache, routing switches have a static ARP table. Entries in the static ARP table are user-configured. You can add entries to the static ARP table regardless of whether the device the entry is for is connected to the routing switch.

NOTE: The routing switches have a static ARP table but the HP 6208M-SX does not.

The software places an entry from the static ARP table into the ARP cache when the entry's interface comes up.

Here is an example of a static ARP entry:

```
Index   IP Address          MAC Address         Port
1       207.95.6.111        0800.093b.d210      1/1
```

Each entry lists the information you specified when you created the entry.

To display ARP entries, see the following:

- “Displaying the ARP Cache” on page 6-85 – routing switch
- “Displaying the Static ARP Table” on page 6-87 – routing switch only
- “Displaying ARP Entries” on page 6-101 – switch

To configure other ARP parameters, see the following:

- “Configuring ARP Parameters” on page 6-27 – routing switch only

To increase the size of the ARP cache and static ARP table, see the following:

- For dynamic entries, see the “Configuring Basic Features” chapter of the *Installation and Getting Started Guide*. The ip-arp parameter controls the ARP cache size.
- Static entries, “Changing the Maximum Number of Entries the Static ARP Table Can Hold” on page 6-31 – routing switches only. The ip-static-arp parameter controls the static ARP table size.

IP Route Table

The IP route table contains paths to IP destinations.

NOTE: The HP 6208M-SX does not have an IP route table. The switch sends all packets addressed to another sub-net to the default gateway, which you specify when you configure the basic IP information on the switch.

The IP route table can receive the paths from the following sources:

- A directly-connected destination, which means there are no router hops to the destination
- A static IP route, which is a user-configured route
- A route learned through RIP
- A route learned through OSPF
- A route learned through BGP4

The IP route table contains the best path to a destination.

- When the software receives paths from more than one of the sources listed above, the software compares the administrative distance of each path and selects the path with the lowest administrative distance. The administrative distance is a protocol-independent value from 1 – 255.
- When the software receives two or more best paths from the same source and the paths have the same metric (cost), the software can load share traffic among the paths based on destination host or network address (based on the configuration).

Here is an example of an entry in the IP route table:

```
Destination      NetMask          Gateway          Port   Cost   Type
1.1.0.0          255.255.0.0      99.1.1.2         1/1    2      R
```

Each IP route table entry contains the destination’s IP address and sub-net mask and the IP address of the next-hop router interface to the destination. Each entry also indicates the port attached to the destination or the next-hop to the destination, the route’s IP metric (cost), and the type. The type indicates how the IP route table received the route.

To display the IP route table, see the following:

- “Displaying the IP Route Table” on page 6-90 – routing switch only

To configure a static IP route, see the following:

- “Configuring Static Routes” on page 6-36 – routing switch only

To clear a route from the IP route table, see the following:

- “Clearing IP Routes” on page 6-93 – routing switch only

To increase the size of the IP route table for learned and static routes, see the “Configuring Basic Features” chapter of the *Installation and Getting Started Guide*:

- For learned routes, modify the ip-route parameter.
- For static routes, modify the ip-static-route parameter.

IP Forwarding Cache

The IP forwarding cache provides a fast-path mechanism for forwarding IP packets. The cache contains entries for IP destinations. When an HP ProCurve routing switch has completed processing and addressing for a packet and is ready to forward the packet, the device checks the IP forwarding cache for an entry to the packet’s destination.

- If the cache contains an entry with the destination IP address, the device uses the information in the entry to forward the packet out the ports listed in the entry. The destination IP address is the address of the packet’s final destination. The port numbers are the ports through which the destination can be reached.
- If the cache does not contain an entry and the traffic does not qualify for an entry in the session table instead, the software can create an entry in the forwarding cache.

Each entry in the IP forwarding cache has an age timer. If the entry remains unused for ten minutes, the software removes the entry. The age timer is not configurable.

NOTE: The HP 6208M-SX does not have an IP forwarding cache.

Here is an example of an entry in the IP forwarding cache:

```
      IP Address       Next Hop         MAC              Type  Port  Vlan  Pri
1     192.168.1.11     DIRECT           0000.0000.0000   PU    n/a         0
```

Each IP forwarding cache entry contains the IP address of the destination, and the IP address and MAC address of the next-hop router interface to the destination. If the destination is actually an interface configured on the routing switch itself, as shown here, then next-hop information indicates this. The port through which the destination is reached is also listed, as well as the VLAN and Layer 4 QoS priority associated with the destination if applicable.

To display the IP forwarding cache, see “Displaying the Forwarding Cache” on page 6-88.

NOTE: You cannot add static entries to the IP forwarding cache, although chassis routing switches do have options to optimize the cache and increase the number of entries the cache can contain. See “Optimizing the IP Forwarding Cache” on page 6-60 and the “Configuring Basic Features” chapter of the *Installation and Getting Started Guide*.

To increase the size of the IP forwarding cache, see the “Configuring Basic Features” chapter of the *Installation and Getting Started Guide*. The ip-cache parameter controls the size of the IP forwarding cache.

Layer 4 Session Table

The Layer 4 session provides a fast path for forwarding packets. A ***session*** is an entry that contains complete Layer 3 and Layer 4 information for a flow of traffic. Layer 3 information includes the source and destination IP addresses. Layer 4 information includes the source and destination TCP and UDP ports. For comparison, the IP forwarding cache contains the Layer 3 destination address but does not contain the other source and destination address information of a Layer 4 session table entry.

The switch or routing switch selects the session table instead of the IP forwarding table for fast-path forwarding for the following features:

- Policy-Based Routing (PBR)
- Layer 4 Quality-of-Service (QoS) policies
- IP access policies

To increase the size of the session table, see the “Configuring Basic Features” chapter of the *Installation and Getting Started Guide*. The ip-qos-session parameter controls the size of the session table.

IP Route Exchange Protocols

HP ProCurve routing switches support the following IP route exchange protocols:

- Routing Information Protocol (RIP)
- Open Shortest Path First (OSPF)
- Border Gateway Protocol version 4 (BGP4)

All these protocols provide routes to the IP route table. You can use one or more of these protocols, in any combination. The protocols are disabled by default. For configuration information, see the following:

- “Configuring RIP” on page 7-1
- “Configuring OSPF” on page 8-1
- “Configuring BGP4” on page 10-1

IP Multicast Protocols

HP ProCurve routing switches also support the following Internet Group Membership Protocol (IGMP) based IP multicast protocols:

- Protocol Independent Multicast – Dense mode (PIM-DM)
- Protocol Independent Multicast – Sparse mode (PIM-SM)
- Distance Vector Multicast Routing Protocol (DVMRP)

For configuration information, see “Configuring IP Multicast Protocols” on page 9-1.

NOTE: The HP 6208M-SX supports IGMP and can forward IP multicast packets. See the “Configuring Basic Features” chapter of the *Installation and Getting Started Guide*.

IP Interface Redundancy Protocols

You can configure an HP ProCurve routing switch to back up an IP interface configured on another HP ProCurve routing switch. If the link for the backed up interface becomes unavailable, the other routing switch can continue service for the interface. This feature is especially useful for providing a backup to a network’s default gateway.

HP ProCurve routing switches support the following IP interface redundancy protocols:

- Virtual Router Redundancy Protocol (VRRP) – A standard router redundancy protocol based on RFC 2338. You can use VRRP to configure HP routing switches and third-party routers to back up IP interfaces on other HP routing switches or third-party routers.
- Virtual Router Redundancy Protocol Extended (VRRPE) – An HP extension to standard VRRP that adds additional features and overcomes limitations in standard VRRP. You can use VRRPE only on HP routing switches.
- Standby Router Protocol (SRP) – An HP router redundancy protocol developed before VRRP and VRRPE that provides some of the features of VRRP and some of the features of VRRPE. You can use SRP only on the HP 9304M, HP 9308M, and HP 6308M-SX routing switches.

For configuration information, see the following:

- Virtual Router Redundancy Protocol Extended (VRRPE) – see “Configuring VRRP and VRRPE” on page 12-1.
- Virtual Router Redundancy Protocol (VRRP) – see “Configuring VRRP and VRRPE” on page 12-1.
- Standby Router Protocol (SRP) – see “Configuring SRP” on page 13-1

Network Address Translation

HP’s chassis routing switches support Network Address Translation (NAT). NAT enables private IP networks that use nonregistered IP addresses to connect to the Internet. Configure NAT on an HP routing switch that is placed at the border of an inside network and an outside network (such as the Internet). NAT translates the internal local addresses to globally unique IP addresses before sending packets to the outside network.

For configuration information, see “Network Address Translation” on page 11-1.

Access Control Lists and IP Access Policies

HP routing switches provide two mechanisms for filtering IP traffic:

- Access Control Lists (ACLs)
- IP access policies

Both methods allow you to filter packets based on Layer 3 and Layer 4 source and destination information.

ACLs also provide great flexibility by providing the input to various other filtering mechanisms such as route maps, which are used by BGP4. ACLs also provide the input for Policy-Based Routing (PBR), which allows you to selectively modify and route IP packets based on their source IP address.

IP access policies allow you to configure QoS based on sessions (Layer 4 traffic flows).

Only one of these filtering mechanisms can be enabled on an HP device at a time. HP devices can store forwarding information for both methods of filtering in the session table.

For configuration information, see the following:

- “Using Access Control Lists (ACLs)” on page 3-1
- “Policies and Filters” on page C-1

Basic IP Parameters and Defaults – Routing Switches

IP is enabled by default. The following IP-based protocols are all disabled by default:

- Route exchange protocols
  - Routing Information Protocol (RIP) – see “Configuring RIP” on page 7-1
  - Open Shortest Path First (OSPF) – see “Configuring OSPF” on page 8-1
  - Border Gateway Protocol version 4 (BGP4) – see “Configuring BGP4” on page 10-1
- Multicast protocols
  - Internet Group Membership Protocol (IGMP) – see “Changing Global IP Multicast Parameters” on page 9-2
  - Protocol Independent Multicast Dense (PIM-DM) – see “PIM Dense Overview” on page 9-4
  - Protocol Independent Multicast Sparse (PIM-SM) – see “PIM Sparse Overview” on page 9-12
  - Distance Vector Multicast Routing Protocol (DVMRP) – see “DVMRP Overview” on page 9-39
- Router redundancy protocols
  - Virtual Router Redundancy Protocol Extended (VRRPE) – see “Configuring VRRP and VRRPE” on page 12-1.
  - Virtual Router Redundancy Protocol (VRRP) – see “Configuring VRRP and VRRPE” on page 12-1.
  - Standby Router Protocol (SRP) – see “Configuring SRP” on page 13-1

The following tables list the routing switch IP parameters, their default values, and where to find configuration information.

NOTE: For information about parameters in other protocols based on IP, such as RIP, OSPF, and so on, see the configuration chapters for those protocols.

When Parameter Changes Take Effect

Most IP parameters described in this chapter are dynamic. They take effect immediately, as soon as you enter the CLI command or select the Web management interface option. You can verify that a dynamic change has taken effect by displaying the running-config. To display the running-config, enter the **show running-config** or **write terminal** command at any CLI prompt. (You cannot display the running-config from the Web management interface.)

To save a configuration change permanently so that the change remains in effect following a system reset or software reload, save the change to the startup-config file.

- To save configuration changes to the startup-config file, enter the **write memory** command from the Privileged EXEC level of any configuration level of the CLI.
- To save the configuration changes using the Web management interface, select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory. You also can access the dialog for saving configuration changes by clicking on Command in the tree view, then clicking on Save to Flash.

Changes to memory allocation require you to reload the software after you save the changes to the startup-config file. When reloading the software is required to complete a configuration change described in this chapter, the procedure that describes the configuration change includes a step for reloading the software.

IP Global Parameters – Routing Switches

Table 6.1 lists the IP global parameters for routing switches.

Table 6.1: IP Global Parameters – routing switches

Parameter	Description	Default	See page...
IP state	The Internet Protocol, version 4	Enabled **Note**: You cannot disable IP.	n/a
IP address and mask notation	Format for displaying an IP address and its network mask information. You can enable one of the following: • Class-based format; example: 192.168.1.1 255.255.255.0 • Classless Interdomain Routing (CIDR) format; example: 192.168.1.1/24	Class-based **Note**: Changing this parameter affects the display of IP addresses, but you can enter addresses in either format regardless of the display setting.	6-80
Router ID	The value that routers use to identify themselves to other routers when exchanging route information. OSPF and BGP4 use router IDs to identify routers. RIP does not use the router ID.	The lowest-numbered IP address configured on the lowest-numbered virtual routing interface (VE). If no VE is configured, then the lowest-numbered IP address configured on the device.	6-25
Address Resolution Protocol (ARP)	A standard IP mechanism that routers use to learn the Media Access Control (MAC) address of a device on the network. The router sends the IP address of a device in the ARP request and receives the device's MAC address in an ARP reply.	Enabled	6-27
ARP age	The amount of time the device keeps a MAC address learned through ARP in the device's ARP cache. The device resets the timer to zero each time the ARP entry is refreshed and removes the entry if the timer reaches the ARP age.	Ten minutes	6-28
Proxy ARP	An IP mechanism a router can use to answer an ARP request on behalf of a host, by replying with the router's own MAC address instead of the host's.	Disabled	6-29
Static ARP entries	An ARP entry you place in the static ARP table. Static entries do not age out.	No entries	6-29
Time to Live (TTL)	The maximum number of routers (hops) through which a packet can pass before being discarded. Each router decreases a packet's TTL by 1 before forwarding the packet. If decreasing the TTL causes the TTL to be 0, the router drops the packet instead of forwarding it.	64 hops	6-32

Table 6.1: IP Global Parameters – routing switches (Continued)

Parameter	Description	Default	See page...
Directed broadcast forwarding	A directed broadcast is a packet containing all ones (or in some cases, all zeros) in the host portion of the destination IP address. When a router forwards such a broadcast, it sends a copy of the packet out each of its enabled IP interfaces. **Note**: You also can enable or disable this parameter on an individual interface basis. See Table 6.2 on page 6-14.	Disabled	6-32
Directed broadcast mode	The packet format the router treats as a directed broadcast. The following formats can be directed broadcast: • All ones in the host portion of the packet's destination address. • All zeroes in the host portion of the packet's destination address.	All ones **Note**: If you enable all-zeroes directed broadcasts, all-ones directed broadcasts remain enabled.	6-34
Source-routed packet forwarding	A source-routed packet contains a list of IP addresses through which the packet must pass to reach its destination.	Enabled	6-33
ICMP Router Discovery Protocol (IRDP)	An IP protocol a router can use to advertise the IP addresses of its router interfaces to directly attached hosts. You can enable or disable the protocol, and change the following protocol parameters: • Forwarding method (broadcast or multicast) • Hold time • Maximum advertisement interval • Minimum advertisement interval • Router preference level **Note**: You also can enable or disable IRDP and configure the parameters on an individual interface basis. See Table 6.2 on page 6-14.	Disabled	6-62
Reverse ARP (RARP)	A IP mechanism a host can use to request an IP address from a directly attached router when the host boots.	Enabled	6-64
Static RARP entries	An IP address you place in the RARP table for RARP requests from hosts. **Note**: You must enter the RARP entries manually. The routing switch does not have a mechanism for learning or dynamically generating RARP entries.	No entries	6-66
Maximum BootP relay hops	The maximum number of hops away a BootP server can be located from a router and still be used by the router's clients for network booting.	Four	6-72

Table 6.1: IP Global Parameters – routing switches (Continued)

Parameter	Description	Default	See page...
Domain name for Domain Name Server (DNS) resolver	A domain name (example: amaynes.router.com) you can use in place of an IP address for certain operations such as IP pings, trace routes, and Telnet management connections to the router.	None configured	6-21
DNS default gateway addresses	A list of gateways attached to the router through which clients attached to the router can reach DNSs.	None configured	6-21
IP unicast cache performance mode	The amount of available IP cache that is set aside for IP unicast entries. When the router caches unicast forwarding entries, the cached entries provide an optimal path through the router because the router CPU does not need to process the packets for forwarding. Once a packet is processed, the forwarding information is placed in the cache for reuse. Chassis devices provide an optional high-performance mode for allocating additional cache space for unicast forwarding entries. Use this option when the router is handling a very large number of unicast flows (source plus destination pairs) and you want to ensure that more flows can remain in the cache at one time.	Standard	6-60
IP load sharing	A feature that enables the router to balance traffic to a specific destination across multiple equal-cost paths. Load sharing uses a simple round-robin mechanism and is based on destination address. **Note**: Load sharing is sometimes called Equal Cost Multi Path (ECMP).	Enabled	6-48
IP load sharing aggregation	A feature on Chassis devices that increases the capacity of the load sharing cache by aggregating destination addresses into networks. When IP load sharing aggregation is enabled, each cache entry is an aggregate network for multiple destination hosts. If IP load sharing aggregation not enabled, the device creates a separate load sharing cache entry for each destination host address. **Note**: Load sharing aggregation is not available on Fixed-port devices. Fixed-port devices cache load sharing entries based on destination host addresses.	On Chassis devices, aggregated by network On Fixed-port devices, single host entries	6-58
Maximum IP load sharing paths	The maximum number of equal-cost paths across which the router is allowed to distribute traffic.	Four	6-59

Table 6.1: IP Global Parameters – routing switches (Continued)

Parameter	Description	Default	See page...
Origination of default routes	You can enable a router to originate default routes for the following route exchange protocols, on an individual protocol basis: • RIP • OSPF • BGP4	Disabled	7-10 8-32 10-29
Default route aggregation	Optimizes forwarding cache space by aggregating cache entries for destinations to which the router forwards traffic using a default route. When you enable default route aggregation, the router makes a single cache entry for a destination network instead of multiple entries for the hosts on the network.	Separate cache entry for each destination host	6-61
Default network route	The router uses the default network route if the IP route table does not contain a route to the destination and also does not contain an explicit default route (0.0.0.0 0.0.0.0 or 0.0.0.0/0).	None configured	6-46
Static route	An IP route you place in the IP route table.	No entries	6-36
Source interface	The IP address the router uses as the source address for Telnet, RADIUS, or TACACS/TACACS+ packets originated by the router. The router can select the source address based on either of the following: • The lowest-numbered IP address on the interface the packet is sent on. • The lowest-numbered IP address on a specific interface. The address is used as the source for all packets of the specified type regardless of interface the packet is sent on.	The lowest-numbered IP address on the interface the packet is sent on.	6-26

IP Interface Parameters – Routing Switches

Table 6.2 lists the interface-level IP parameters for routing switches.

Table 6.2: IP Interface Parameters – routing switches

Parameter	Description	Default	See page...
IP state	The Internet Protocol, version 4	Enabled **Note**: You cannot disable IP.	n/a
IP address	A Layer 3 network interface address **Note**: The HP 6208M-SX has a single IP address used for management access to the entire device. The routing switches have separate IP addresses on individual interfaces.	None configured[a]	6-18
Encapsulation type	The format of the packets in which the router encapsulates IP datagrams. The encapsulation format can be one of the following: • Ethernet II • SNAP	Ethernet II	6-23
Maximum Transmission Unit (MTU)	The maximum length (number of bytes) of an encapsulated IP datagram the router can forward.	1500 for Ethernet II encapsulated packets 1492 for SNAP encapsulated packets	6-24
Metric	A numeric cost the router adds to RIP routes learned on the interface. This parameter applies only to RIP routes.	1 (one)	7-5
Directed broadcast forwarding	Locally overrides the global setting. See Table 6.1 on page 6-10.	Disabled	6-32
ICMP Router Discovery Protocol (IRDP)	Locally overrides the global IRDP settings. See Table 6.1 on page 6-10.	Disabled	6-64
DHCP gateway stamp	The router can assist DHCP/BootP Discovery packets from one sub-net to reach DHCP/BootP servers on a different sub-net by placing the IP address of the router interface that receives the request in the request packet's Gateway field. You can override the default and specify the IP address to use for the Gateway field in the packets. **Note**: UDP broadcast forwarding for client DHCP/ BootP requests (bootpc) must be enabled and you must configure an IP helper address (the server's IP address or a directed broadcast to the server's sub-net) on the port connected to the client.	The lowest-numbered IP address on the interface that receives the request	6-71

Table 6.2: IP Interface Parameters – routing switches (Continued)

Parameter	Description	Default	See page...
UDP broadcast forwarding	The router can forward UDP broadcast packets for UDP applications such as BootP. By forwarding the UDP broadcasts, the router enables clients on one sub-net to find servers attached to other sub-nets. **Note**: To completely enable a client's UDP application request to find a server on another sub-net, you must configure an IP helper address consisting of the server's IP address or the directed broadcast address for the sub-net that contains the server. See the next row.	The router helps forward broadcasts for the following UDP application protocols: • bootps • dns • netbios-dgm • netbios-ns • tacacs • tftp • time	6-68
IP helper address	The IP address of a UDP application server (such as a BootP or DHCP server) or a directed broadcast address. IP helper addresses allow the router to forward requests for certain UDP applications from a client on one sub-net to a server on another sub-net.	None configured	6-69

a.Some devices have a factory default, such as 209.157.22.154, used for troubleshooting during installation. For routing switches, the address is on port 1 (or 1/1).

Basic IP Parameters and Defaults – HP 6208M-SX

IP is enabled by default. The following tables list the switch IP parameters, their default values, and where to find configuration information.

NOTE: The HP 6208M-SX also provides IP multicast forwarding, which is enabled by default. For information about this feature, see the “Configuring Basic Features” chapter of the *Installation and Getting Started Guide*.

IP Global Parameters – HP 6208M-SX

Table 6.3 lists the IP global parameters for the switch.

Table 6.3: IP Global Parameters – switch

Parameter	Description	Default	See page...
IP address and mask notation	Format for displaying an IP address and its network mask information. You can enable one of the following: • Class-based format; example: 192.168.1.1 255.255.255.0 • Classless Interdomain Routing (CIDR) format; example: 192.168.1.1/24	Class-based **Note**: Changing this parameter affects the display of IP addresses, but you can enter addresses in either format regardless of the display setting.	6-80
IP address	A Layer 3 network interface address **Note**: The HP 6208M-SX has a single IP address used for management access to the entire device. routing switches have separate IP addresses on individual interfaces.	None configured[a]	6-73
Default gateway	The IP address of a locally attached router (or a router attached to the switch by bridges or other switches). The switch and clients attached to it use the default gateway to communicate with devices on other sub-nets.	None configured	6-73
Address Resolution Protocol (ARP)	A standard IP mechanism that networking devices use to learn the Media Access Control (MAC) address of another device on the network. The switch sends the IP address of a device in the ARP request and receives the device’s MAC address in an ARP reply.	Enabled **Note**: You cannot disable ARP.	n/a
ARP age	The amount of time the device keeps a MAC address learned through ARP in the device’s ARP cache. The device resets the timer to zero each time the ARP entry is refreshed and removes the entry if the timer reaches the ARP age.	Ten minutes **Note**: You cannot change the ARP age on switches.	n/a
Time to Live (TTL)	The maximum number of routers (hops) through which a packet can pass before being discarded. Each router decreases a packet’s TTL by 1 before forwarding the packet. If decreasing the TTL causes the TTL to be 0, the router drops the packet instead of forwarding it.	64 hops	6-76

Table 6.3: IP Global Parameters – switch (Continued)

Parameter	Description	Default	See page...
Domain name for Domain Name Server (DNS) resolver	A domain name (example: amaynes.router.com) you can use in place of an IP address for certain operations such as IP pings, trace routes, and Telnet management connections to the router.	None configured	6-74
DNS default gateway addresses	A list of gateways attached to the router through which clients attached to the router can reach DNSs.	None configured	6-74
Source interface	The IP address the switch uses as the source address for Telnet, RADIUS, or TACACS/TACACS+ packets originated by the router. The switch uses its management IP address as the source address for these packets.	The management IP address of the switch. **Note**: This parameter is not configurable on the HP 6208M-SX.	n/a
DHCP gateway stamp	The device can assist DHCP/BootP Discovery packets from one sub-net to reach DHCP/BootP servers on a different sub-net by placing the IP address of the router interface that forwards the packet in the packet's Gateway field. You can specify up to 32 gateway lists. A gateway list contains up to eight gateway IP addresses. You activate DHCP assistance by associating a gateway list with a port. When you configure multiple IP addresses in a gateway list, the switch inserts the addresses into the DHCP Discovery packets in a round robin fashion.	None configured	6-79

a.Some devices have a factory default, such as 209.157.22.154, used for troubleshooting during installation. For routing switches, the address is on port 1 (or 1/1).

Interface IP Parameters – HP 6208M-SX

Table 6.4 lists the interface-level IP parameters for the HP 6208M-SX.

Table 6.4: Interface IP Parameters – switch

Parameter	Description	Default	See page...
DHCP gateway stamp	You can configure a list of DHCP stamp addresses for a port. When the port receives a DHCP/BootP Discovery packet from a client, the port places the IP address(es) in the gateway list into the packet's Gateway field.	None configured	6-79

Configuring IP Parameters – Routing Switches

The following sections describe how to configure IP parameters. Some parameters can be configured globally while others can be configured on individual interfaces. Some parameters can be configured globally and overridden for individual interfaces.

NOTE: This section describes how to configure IP parameters for routing switches. For IP configuration information for the HP 6208M-SX, see “Configuring IP Parameters – HP 6208M-SX” on page 6-73.

Configuring IP Addresses

You can configure an IP address on the following types of routing switch interfaces:

- Ethernet port
- Virtual routing interface (also called a Virtual Ethernet or “VE”)
- Loopback interface

By default, you can configure up to 24 IP addresses on each interface. On the HP 6308M-SX, you can increase this amount to up to 64 IP sub-net addresses per port by increasing the size of the subnet-per-interface table. See the “Configuring Basic Features” chapter of the *Installation and Getting Started Guide*.

HP ProCurve devices support both classical IP network masks (Class A, B, and C sub-net masks, and so on) and Classless Interdomain Routing (CIDR) network prefix masks.

- To enter a classical network mask, enter the mask in IP address format. For example, enter “209.157.22.99 255.255.255.0” for an IP address with a Class-C sub-net mask.
- To enter a prefix network mask, enter a forward slash (/) and the number of bits in the mask immediately after the IP address. For example, enter “209.157.22.99/24” for an IP address that has a network mask with 24 significant bits (ones).

By default, the CLI displays network masks in classical IP address format (example: 255.255.255.0). You can change the display to prefix format. See “Changing the Network Mask Display to Prefix Format” on page 6-80.

Assigning an IP Address to an Ethernet Port

To assign an IP address to an Ethernet port, use either of the following methods.

USING THE CLI

To assign an IP address to port 1/1, enter the following commands:

```
HP9300(config)# interface ethernet 1/1
HP9300(config-if-1/1)# ip address 192.45.6.1 255.255.255.0
```

Syntax: ip address <ip-addr> <ip-mask> [secondary]

or

Syntax: ip address <ip-addr>/<mask-bits> [secondary]

Use the **secondary** parameter if you have already configured an IP address within the same sub-net on the interface.

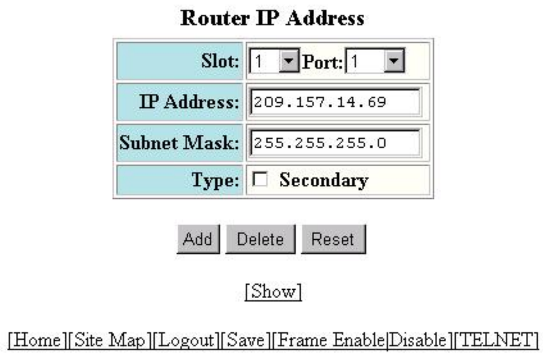
NOTE: You also can enter the IP address and mask in CIDR format, as follows:

```
HP9300(config-if-1/1)# ip address 192.45.6.1/24
```

USING THE WEB MANAGEMENT INTERFACE

To assign an IP address and mask to a router interface:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Select the IP Address link. The IP addresses already configured on the device are listed in a table. Select Add IP Address to display the following panel.



3. Select the port (and slot if applicable) on which you want to configure the address.

NOTE: This example shows the panel for configuring an address on a routing switch. On the HP 6208M-SX, the IP address is global and applies to all the switch's ports. Thus, you do not need to select a port.

---

4. Enter the IP address and network mask.
5. If the port already has an IP address configured, select the Secondary checkbox.
6. Click the Add button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

NOTE: You also can access the dialog for saving configuration changes by clicking on Command in the tree view, then clicking on Save to Flash.

Assigning an IP Address to a Loopback Interface

Loopback interfaces are always up, regardless of the states of physical interfaces. They can add stability to the network because they are not subject to route flap problems that can occur due to unstable links between a routing switch and other devices. You can configure up to eight loopback interfaces on a routing switch.

You can add up to 24 IP addresses to each loopback interface.

NOTE: If you configure the HP routing switch to use a loopback interface to communicate with a BGP4 neighbor, you also must configure a loopback interface on the neighbor and configure the neighbor to use that loopback interface to communicate with the HP routing switch. See "Adding a Loopback Interface" on page 10-13.

To add a loopback interface, use one of the following methods.

USING THE CLI

To add a loopback interface, enter commands such as those shown in the following example:

```
HP9300(config-bgp-router)# exit
HP9300(config)# int loopback 1
```

```
HP9300(config-lbif-1)# ip address 10.0.0.1/24
```

Syntax: interface loopback <num>

The <num> value can be from 1 – 8.

Syntax: [no] ip address <ip-addr> <ip-mask> [secondary]

or

Syntax: [no] ip address <ip-addr>/<mask-bits> [secondary]

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Select the IP Address link to display a table listing the configured IP addresses.
3. Select the Loop Back link.

NOTE: If the device already has loopback interfaces, a table listing the interfaces is displayed. Click the Modify button to the right of the row describing an interface to change its configuration, or click the Add Loop Back link to display the Router Loop Back configuration panel.

4. Select the loopback interface number from the Loopback field's pulldown menu. You can select from 1 – 8.
5. Select the status. The interface is enabled by default.
6. Click Add to add the new interface.
7. Click on Configure in the tree view to display the configuration options.
8. Click on IP to display the IP configuration options.
9. Select the Add IP Address link to display the Router IP Address panel.
10. Select the loopback interface from the Port field's pulldown menu. For example, to select loopback interface 1, select "lb1". (If you are configuring a Chassis device, you can have any slot number in the Slot field. Loopback interfaces are not associated with particular slots or physical ports.)
11. Enter the loopback interface's IP address in the IP Address field.
12. Enter the network mask in the Subnet Mask field.
13. Click the Add button to save the change to the device's running-config file.
14. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Assigning an IP Address to a Virtual Interface

A virtual interface is a logical port associated with a Layer 3 Virtual LAN (VLAN) configured on a routing switch. You can configure routing parameters on the virtual interface to enable the routing switch to route protocol traffic from one Layer 3 VLAN to the other, without using an external router.[1]

You can configure IP, IPX, or AppleTalk routing interface parameters on a virtual interface. This section describes how to configure an IP address on a virtual interface. Other sections in this chapter that describe how to configure interface parameters also apply to virtual interfaces.

NOTE: The routing switch uses the lowest MAC address on the device (the MAC address of port 1 or 1/1) as the MAC address for all ports within all virtual interfaces you configure on the device.

1.HP's feature that allows routing between VLANs within the same device, without the need for external routers, is called Integrated Switch Routing (ISR). See "Integrated Switch Routing (ISR)" on page 16-3.

For more information about VLANs and how to configure them, see “Configuring VLANs” on page 16-1.

USING THE CLI

To add a virtual interface to a VLAN and configure an IP address on the interface, enter commands such as the following:

```
HP9300(config)# vlan 2 name IP-Subnet_1.1.2.0/24
HP9300(config-vlan-2)# untag e1 to 4
HP9300(config-vlan-2)# router-interface ve1
HP9300(config-vlan-2)# interface ve1
HP9300(config-vif-1)# ip address 1.1.2.1/24
```

The first two commands in this example create a Layer 3 protocol-based VLAN name “IP-Subnet_1.1.2.0/24” and add a range of untagged ports to the VLAN. The **router-interface** command creates virtual interface 1 as the routing interface for the VLAN. The last two commands change to the interface configuration level for the virtual interface and assign an IP address to the interface.

Syntax: router-interface ve <num>

Syntax: interface ve <num>

The <num> value can be from 1 – 8.

Syntax: [no] ip address <ip-addr> <ip-mask> [secondary]

or

Syntax: [no] ip address <ip-addr>/<mask-bits> [secondary]

Deleting an IP Address

To delete an IP address, enter a command such as the following:

```
HP9300(config-if-1/1)# no ip address 1.1.2.1
```

This command deletes IP address 1.1.2.1. You do not need to enter the subnet mask.

To delete all IP addresses from an interface, enter the following command:

```
HP9300(config-if-1/1)# no ip address *
```

Syntax: no ip address <ip-addr> | *

Configuring Domain Name Server (DNS) Resolver

The Domain Name Server (DNS) resolver feature lets you use a host name to perform Telnet, ping, and traceroute commands. You can also define a DNS domain on the device and thereby recognize all hosts within that domain. After you define a domain name, the device automatically appends the appropriate domain to the host and forwards it to the domain name server.

For example, if the domain “newyork.com” is defined on a device and you want to initiate a ping to host “NYC01” on that domain, you need to reference only the host name in the command instead of the host name and its domain name. For example, you could enter either of the following commands to initiate the ping:

```
HP9300# ping nyc01
HP9300# ping nyc01.newyork.com
```

Defining a DNS Entry

You can define up to four DNS servers for each DNS entry. The first entry serves as the primary default address. If a query to the primary address fails to be resolved after three attempts, the next gateway address is queried (also up to three times). This process continues for each defined gateway address until the query is resolved. The order in which the default gateway addresses are polled is the same as the order in which you enter them.

USING THE CLI

Suppose you want to define the domain name of newyork.com on a routing switch and then define four possible default DNS gateway addresses. To do so, enter the following commands:

```
HP9300(config)# ip dns domain-name newyork.com
HP9300(config)# ip dns server-address 209.157.22.199 205.96.7.15 208.95.7.25
201.98.7.15
```

Syntax: ip dns server-address <ip-addr> [<ip-addr>] [<ip-addr>] [<ip-addr>]

In this example, the first IP address in the **ip dns server-address...** command becomes the primary gateway address and all others are secondary addresses. Because IP address 201.98.7.15 is the last address listed, it is also the last address consulted to resolve a query.

USING THE WEB MANAGEMENT INTERFACE

To map a domain name server to multiple IP addresses:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Do one of the following:
   - On the HP 6208M-SX – Select the DNS link to display the DNS panel.
   - On a routing switch – Click on the plus sign next to Configure in the tree view, then click on the plus sign next to IP, then select DNS to display the DNS panel.
3. Enter the domain name in the Domain Name field.
4. Enter an IP address for each device that will serve as a gateway to the domain name server.

   NOTE: The first address entered will be the primary DNS gateway address. The other addresses will be used in chronological order, left to right, if the primary address is available.

5. Click the Apply button to save the change to the device's running-config file.
6. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Using a DNS Name To Initiate a Trace Route

Suppose you want to trace the route from a routing switch to a remote server identified as NYC02 on domain newyork.com. Because the newyork.com domain is already defined on the routing switch, you need to enter only the host name, NYC02, as noted below.

USING THE CLI

```
HP9300# traceroute nyc02
```

Syntax: traceroute <host-ip-addr> [maxttl <value>] [minttl <value>] [numeric] [timeout <value>]
[source-ip <ip addr>]

The only required parameter is the IP address of the host at the other end of the route. See the *Command Line Interface Reference* for information about the parameters.

After you enter the command, a message indicating that the DNS query is in process and the current gateway address (IP address of the domain name server) being queried appear on the screen:

```
Type Control-c to abort
Sending DNS Query to 209.157.22.199
Tracing Route to IP node 209.157.22.80
To ABORT Trace Route, Please use stop-traceroute command.
 Traced route to target IP node 209.157.22.80:
   IP Address          Round Trip Time1    Round Trip Time2
  207.95.6.30         93 msec             121 msec
```

NOTE: In the above example, 209.157.22.199 is the IP address of the domain name server (default DNS gateway address), and 209.157.22.80 represents the IP address of the NYC02 host.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Command in the tree view to list the command options.
3. Select the Trace Route link to display the Trace Route panel.
4. Enter the host name or IP address in the Target Address field.

NOTE: You can use the host name only if you have already configured the DNS resolver for the domain that contains the host.

5. Optionally change the minimum and maximum TTLs and the Timeout.
6. Click on Start to begin the trace. The trace results are displayed below the Start and Abort buttons.

Configuring Packet Parameters

You can configure the following packet parameters on routing switches. These parameters control how the routing switch sends IP packets to other devices on an Ethernet network. The routing switch always places IP packets into Ethernet packets to forward them on an Ethernet port.

- Encapsulation type – The format for the Layer 2 packets within which the routing switch sends IP packets.
- Maximum Transmission Unit (MTU) – The maximum length of IP packet that a Layer 2 packet can contain. IP packets that are longer than the MTU are fragmented and sent in multiple Layer 2 packets.

Changing the Encapsulation Type

The routing switch encapsulates IP packets into Layer 2 packets, to send the IP packets on the network. (A Layer 2 packet is also called a MAC layer packet or an Ethernet frame.) The source address of a Layer 2 packet is the MAC address of the routing switch interface sending the packet. The destination address can be one of the following:

- The MAC address of the IP packet's destination. In this case, the destination device is directly connected to the routing switch.
- The MAC address of the next-hop gateway toward the packet's destination.
- An Ethernet broadcast address.

The entire IP packet, including the source and destination address and other control information and the data, is placed in the data portion of the Layer 2 packet. Typically, an Ethernet network uses one of two different formats of Layer 2 packet:

- Ethernet II
- Ethernet SNAP (also called IEEE 802.3)

The control portions of these packets differ slightly. All IP devices on an Ethernet network must use the same format. HP routing switches use Ethernet II by default. You can change the IP encapsulation to Ethernet SNAP on individual ports if needed.

NOTE: All devices connected to the routing switch port must use the same encapsulation type.

To change the encapsulation type on a routing switch port, use either of the following methods.

USING THE CLI

To change the encapsulation type on interface 1/5 to Ethernet SNAP, enter the following commands:

```
HP9300(config)# int e 1/5
HP9300(config-if-5)# ip encapsulation ethernet_snap
```

Syntax: ip encapsulation ethernet_snap | ethernet_ii

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the Interface link to display the interface table.
5. Click on the Modify button in the row for the port.
6. Select the encapsulation type from the Encapsulation pulldown menu.
7. Click the Add button to save the change to the device's running-config file.
8. To configure settings for another port, select the port (and slot, if applicable) and go to step 6.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Changing the Size of the Maximum Transmission Unit (MTU)

The Maximum Transmission Unit (MTU) is the maximum size an IP packet can be when encapsulated in a Layer 2 packet. If an IP packet is larger than the MTU allowed by the Layer 2 packet, the routing switch fragments the IP packet into multiple parts that will fit into the Layer 2 packets, and sends the parts of the fragmented IP packet separately, in different Layer 2 packets. The device that receives the multiple fragments of the IP packet reassembles the fragments into the original packet.

Since the MTU depends on the encapsulation type, and the encapsulation type can be configured on an individual port basis, the MTU also can be configured on an individual port basis.

The default MTU for Ethernet II packets is 1500 bytes. The default for SNAP packets is 1492 bytes.

To change the MTU for a port, use either of the following methods.

USING THE CLI

To change the MTU for interface 1/5 to 1000, enter the following commands:

```
HP9300(config)# int e 1/5
HP9300(config-if-5)# ip mtu 1000
```

Syntax: ip mtu <num>

The <num> parameter specifies the MTU. Ethernet II packets can hold IP packets from 572 – 1500 bytes long. Ethernet SNAP packets can hold IP packets from 572 – 1492 bytes long. The default MTU for Ethernet II packets is 1500. The default MTU for SNAP packets is 1492.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the Interface link to display the interface table.
5. Click on the Modify button in the row for the port.
6. Enter an MTU value from 572 – 1492 if the interface is operating with Ethernet SNAP encapsulation. If the interface is operating with Ethernet II, enter a value from 572 – 1500.
7. Click the Add button to save the change to the device's running-config file.
8. To configure settings for another port, select the port (and slot, if applicable) and go to step 6.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Changing the Router ID

In most configurations, a routing switch has multiple IP addresses, usually configured on different interfaces. As a result, a routing switch's identity to other devices varies depending on the interface to which the other device is attached. Some routing protocols, including Open Shortest Path First (OSPF) and Border Gateway Protocol version 4 (BGP4), identify a routing switch by just one of the IP addresses configured on the routing switch, regardless of the interfaces that connect the routing switches. This IP address is the router ID.

NOTE: Routing Information Protocol (RIP) does not use the router ID.

NOTE: If you change the router ID, all current BGP4 sessions are cleared.

By default, the router ID on an HP routing switch is one of the following:

- If the routing switch has loopback interfaces, the default router ID is the IP address configured on the lowest numbered loopback interface configured on the routing switch. For example, if you configure loopback interfaces 1, 2, and 3 as follows, the default router ID is 9.9.9.9/24:
    - Loopback interface 1, 9.9.9.9/24
    - Loopback interface 2, 4.4.4.4/24
    - Loopback interface 3, 1.1.1.1/24
- If the device does not have any loopback interfaces, the default router ID is the lowest numbered IP interface configured on the device.

If you prefer, you can explicitly set the router ID to any valid IP address. The IP address cannot be in use on another device in the network.

NOTE: HP routing switches use the same router ID for both OSPF and BGP4. If the routing switch is already configured for OSPF, you may want to use the router ID that is already in use on the routing switch rather than set a new one. To display the router ID, enter the **show ip** CLI command at any CLI level or select the IP->General links from the Configure tree in the Web management interface.

USING THE CLI

To change the router ID, enter a command such as the following:

```
HP9300(config)# ip router-id 209.157.22.26
```

Syntax: ip router-id <ip-addr>

The <ip-addr> can be any valid, unique IP address.

NOTE: You can specify an IP address used for an interface on the HP routing switch, but do not specify an IP address in use by another device.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Edit the value in the Router ID field. Specify a valid IP address that is not in use on another device in the network.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Specifying a Single Source Interface for Telnet, TACACS/TACACS+, or RADIUS Packets

When the routing switch originates a Telnet, TACACS/TACACS+, or RADIUS packet, the source address of the packet is the lowest-numbered IP address on the interface that sends the packet. You can configure the routing switch to always the lowest-numbered IP address on a specific interface as the source addresses for these types of packets. When you configure the routing switch to use a single source interface for all Telnet, TACACS/TACACS+, or RADIUS packets, the routing switch uses the same IP address as the source for all packets of the specified type, regardless of the port(s) that actually sends the packets.

Identifying a single source IP address for Telnet, TACACS/TACACS+, or RADIUS packets provides the following benefits:

- If your Telnet, TACACS/TACACS+, or RADIUS server is configured to accept packets only from specific IP addresses, you can use this feature to simplify configuration of the server by configuring the device to always send the packets from the same link or source address.
- If you specify a loopback interface as the single source for Telnet, TACACS/TACACS+, or RADIUS packets, servers can receive the packets regardless of the states of individual links. Thus, if a link to the server becomes unavailable but the client or server can be reached through another link, the client or server still receives the packets, and the packets still have the source IP address of the loopback interface.

The software contains separate CLI commands for specifying the source interface for Telnet, TACACS/TACACS+, or RADIUS packets. You can configure a source interface for one or more of these types of packets separately.

To specify an Ethernet port or a loopback or virtual interface as the source for all TACACS/TACACS+ packets from the device, use the following CLI method. The software uses the lowest-numbered IP address configured on the port or interface as the source IP address for TACACS/TACACS+ packets originated by the device.

USING THE CLI

The following sections show the syntax for specifying a single source IP address for Telnet, TACACS/TACACS+, and RADIUS packets.

Telnet Packets

To specify the lowest-numbered IP address configured on a virtual interface as the device's source for all Telnet packets, enter commands such as the following:

```
HP9300(config)# int loopback 2
HP9300(config-lbif-2)# ip address 10.0.0.2/24
HP9300(config-lbif-2)# exit
HP9300(config)# ip telnet source-interface loopback 2
```

The commands in this example configure loopback interface 2, assign IP address 10.0.0.2/24 to the interface, then designate the interface as the source for all Telnet packets from the routing switch.

Syntax: ip telnet source-interface ethernet <portnum> | loopback <num> | ve <num>

The <num> parameter is a loopback interface or virtual interface number. If you specify an Ethernet port, the <portnum> is the port's number (including the slot number, if you are configuring a chassis device).

The following commands configure an IP interface on an Ethernet port and designate the address port as the source for all Telnet packets from the routing switch.

```
HP9300(config)# interface ethernet 1/4
HP9300(config-if-1/4)# ip address 209.157.22.110/24
HP9300(config-if-1/4)# exit
HP9300(config)# ip telnet source-interface ethernet 1/4
```

TACACS/TACACS+ Packets

To specify the lowest-numbered IP address configured on a virtual interface as the device's source for all TACACS/TACACS+ packets, enter commands such as the following:

```
HP9300(config)# int ve 1
HP9300(config-vif-1)# ip address 10.0.0.3/24
HP9300(config-vif-1)# exit
```

```
HP9300(config)# ip tacacs source-interface ve 1
```

The commands in this example configure virtual interface 1, assign IP address 10.0.0.3/24 to the interface, then designate the interface as the source for all TACACS/TACACS+ packets from the routing switch.

Syntax: ip tacacs source-interface ethernet <portnum> | loopback <num> | ve <num>

The <num> parameter is a loopback interface or virtual interface number. If you specify an Ethernet port, the <portnum> is the port's number (including the slot number, if you are configuring a chassis device).

RADIUS Packets

To specify the lowest-numbered IP address configured on a virtual interface as the device's source for all RADIUS packets, enter commands such as the following:

```
HP9300(config)# int ve 1
HP9300(config-vif-1)# ip address 10.0.0.3/24
HP9300(config-vif-1)# exit
HP9300(config)# ip radius source-interface ve 1
```

The commands in this example configure virtual interface 1, assign IP address 10.0.0.3/24 to the interface, then designate the interface as the source for all RADIUS packets from the routing switch.

Syntax: ip radius source-interface ethernet <portnum> | loopback <num> | ve <num>

The <num> parameter is a loopback interface or virtual interface number. If you specify an Ethernet port, the <portnum> is the port's number (including the slot number, if you are configuring a chassis device).

USING THE WEB MANAGEMENT INTERFACE

You cannot configure a single source interface for Telnet, TACACS/TACACS+, or RADIUS using the Web management interface.

Configuring ARP Parameters

Address Resolution Protocol (ARP) is a standard IP protocol that enables an IP routing switch to obtain the MAC address of another device's interface when the routing switch knows the IP address of the interface. ARP is enabled by default and cannot be disabled.

NOTE: The HP 6208M-SX also supports ARP. The description in "How ARP Works" also applies to ARP on the HP 6208M-SX. However, the configuration options described later in this section apply only to routing switches, not to the HP 6208M-SX.

How ARP Works

A routing switch needs to know a destination's MAC address when forwarding traffic, because the routing switch encapsulates the IP packet in a Layer 2 packet (MAC layer packet) and sends the Layer 2 packet to a MAC interface on a device directly attached to the routing switch. The device can be the packet's final destination or the next-hop router toward the destination.

The routing switch encapsulates IP packets in Layer 2 packets regardless of whether the ultimate destination is locally attached or is multiple router hops away. Since the routing switch's IP route table and IP forwarding cache contain IP address information but not MAC address information, the routing switch cannot forward IP packets based solely on the information in the route table or forwarding cache. The routing switch needs to know the MAC address that corresponds with the IP address of either the packet's locally attached destination or the next-hop router that leads to the destination.

For example, to forward a packet whose destination is multiple router hops away, the routing switch must send the packet to the next-hop router toward its destination, or to a default route or default network route if the IP route table does not contain a route to the packet's destination. In each case, the routing switch must encapsulate the packet and address it to the MAC address of a locally attached device, the next-hop router toward the IP packet's destination.

To obtain the MAC address required for forwarding a datagram, the routing switch does the following:

- First, the routing switch looks in the ARP cache (not the static ARP table) for an entry that lists the MAC

address for the IP address. The ARP cache maps IP addresses to MAC addresses. The cache also lists the port attached to the device and, if the entry is dynamic, the age of the entry. A dynamic ARP entry enters the cache when the routing switch receives an ARP reply or receives an ARP request (which contains the sender's IP address and MAC address). A static entry enters the ARP cache from the static ARP table (which is a separate table) when the interface for the entry comes up.

To ensure the accuracy of the ARP cache, each dynamic entry has its own age timer. The timer is reset to zero each time the routing switch receives an ARP reply or ARP request containing the IP address and MAC address of the entry. If a dynamic entry reaches its maximum allowable age, the entry times out and the software removes the entry from the table. Static entries do not age out and can be removed only by you.

- If the ARP cache does not contain an entry for the destination IP address, the routing switch broadcasts an ARP request out all its IP interfaces. The ARP request contains the IP address of the destination. If the device with the IP address is directly attached to the routing switch, the device sends an ARP response containing its MAC address. The response is a unicast packet addressed directly to the routing switch. The routing switch places the information from the ARP response into the ARP cache.

  ARP requests contain the IP address and MAC address of the sender, so all devices that receive the request learn the MAC address and IP address of the sender and can update their own ARP caches accordingly.

  NOTE: The ARP request broadcast is a MAC broadcast, which means the broadcast goes only to devices that are directly attached to the routing switch. A MAC broadcast is not routed to other networks. However, some routers, including HP routing switches, can be configured to reply to ARP requests from one network on behalf of devices on another network. See “Enabling Proxy ARP” on page 6-29.

NOTE: If the routing switch receives an ARP request packet that it is unable to deliver to the final destination because of the ARP timeout and no ARP response is received (the routing switch knows of no route to the destination address), the routing switch sends an ICMP Host Unreachable message to the source.

Changing the ARP Aging Period

When the routing switch places an entry in the ARP cache, the routing switch also starts an aging timer for the entry. The aging timer ensures that the ARP cache does not retain learned entries that are no longer valid. An entry can become invalid when the device with the MAC address of the entry is no longer on the network.

The ARP age affects dynamic (learned) entries only, not static entries. The default ARP age is ten minutes. On routing switches, you can change the ARP age to a value from 0 – 240 minutes. You cannot change the ARP age on switches. If you set the ARP age to zero, aging is disabled and entries do not age out.

To change the ARP age on a routing switch, use either of the following methods.

USING THE CLI

To modify the ARP aging parameter to 20 minutes, enter the following command:

```
HP9300(config)# ip arp-age 20
```

Syntax: ip arp-age <num>

The <num> parameter specifies the number of minutes and can be from 0 – 240. The default is 10. If you specify 0, aging is disabled.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the list of configuration options.
3. Click on the plus sign next to IP to display the list of IP configuration options.
4. Select the General link to display the IP configuration panel.

5. Enter a value from 0 – 240 into the ARP Age field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Enabling Proxy ARP

Proxy ARP allows a routing switch to answer ARP requests from devices on one network on behalf of devices in another network. Since ARP requests are MAC-layer broadcasts, they reach only the devices that are directly connected to the sender of the ARP request. Thus, ARP requests do not cross routers.

For example, if Proxy ARP is enabled on a routing switch connected to two sub-nets, 10.10.10.0/24 and 20.20.20.0/24, the routing switch can respond to an ARP request from 10.10.10.69 for the MAC address of the device with IP address 20.20.20.69. In standard ARP, a request from a device in the 10.10.10.0/24 sub-net cannot reach a device in the 20.20.20.0 sub-net if the sub-nets are on different network cables, and thus is not answered.

NOTE: An ARP request from one sub-net can reach another sub-net when both sub-nets are on the same physical segment (Ethernet cable), since MAC-layer broadcasts reach all the devices on the segment.

Proxy ARP is disabled by default on HP routing switches. The feature is not supported on the HP 6208M-SX.

To enable Proxy ARP, use either of the following methods.

USING THE CLI

To enable IP proxy ARP, enter the following command:

```
HP9300(config)# ip proxy-arp
```

To again disable IP proxy ARP, enter the following command:

```
HP9300(config)# no ip proxy-arp
```

Syntax: [no] ip proxy-arp

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Select the Enable or Disable radio button next to Proxy ARP.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Creating Static ARP Entries

HP routing switches have a static ARP table, in addition to the regular ARP cache. The static ARP table contains entries that you configure.

Static entries are useful in cases where you want to pre-configure an entry for a device that is not connected to the routing switch, or you want to prevent a particular entry from aging out. The software removes a dynamic entry from the ARP cache if the ARP aging interval expires before the entry is refreshed. Static entries do not age out, regardless of whether the HP device receives an ARP request from the device that has the entry's address.

NOTE: You cannot create static ARP entries on a switch.

The maximum number of static ARP entries you can configure depends on the product. See "Changing the Maximum Number of Entries the Static ARP Table Can Hold" on page 6-31.

To display the ARP cache and static ARP table, see the following:

- To display the ARP table, see “Displaying the ARP Cache” on page 6-85.
- To display the static ARP table, see “Displaying the Static ARP Table” on page 6-87.

To configure a static ARP entry, use either of the following methods.

USING THE CLI

To create a static ARP entry, enter a command such as the following:

```
HP9300(config)# arp 1 192.53.4.2 1245.7654.2348 e 1/2
```

Syntax: arp <num> <ip-addr> <mac-addr> ethernet <portnum>

The <num> parameter specifies the entry number. You can specify a number from 1 up to the maximum number of static entries allowed on the device.

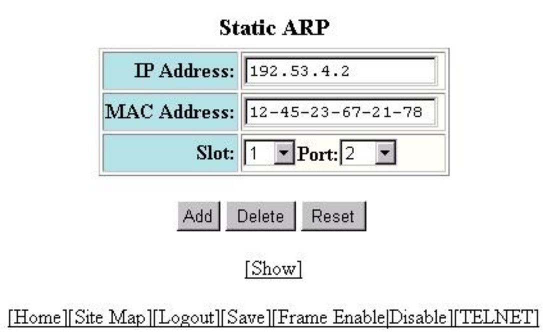
The <ip-addr> command specifies the IP address of the device that has the MAC address of the entry.

The <mac-addr> parameter specifies the MAC address of the entry.

The **ethernet** <portnum> command specifies the port number attached to the device that has the MAC address of the entry.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Click the Static ARP link.
   - If the device does not have any static ARP entries, the Static ARP configuration panel is displayed, as shown in the following example.
   - If a static ARP entry is already configured and you are adding a new entry, click on the Add Static ARP link to display the Static ARP configuration panel, as shown in the following example.
   - If you are modifying an existing static ARP entry, click on the Modify button to the right of the row describing the entry to display the Static ARP configuration panel, as shown in the following example.



6. Enter the IP address. The address must be for a device that is directly connected to the routing switch.
7. Enter the MAC address.
8. Select the port that the static ARP entry is to be assigned to from the pull down menu.
9. Click the Add button to save the change to the device’s running-config file.

10. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Changing the Maximum Number of Entries the Static ARP Table Can Hold

Table 6.5 on page 6-31 lists the default maximum and configurable maximum number of entries in the static ARP table that are supported on each type of HP routing switch. If you need to change the maximum number of entries supported on a routing switch, use either of the following methods.

NOTE: You must save the configuration to the startup-config file and reload the software after changing the static ARP table size to place the change into effect.

NOTE: The basic procedure for changing the static ARP table size is the same as the procedure for changing other configurable cache or table sizes. See the "Configuring Basic Features" chapter of the *Installation and Getting Started Guide*.

USING THE CLI

To increase the maximum number of entries in the static ARP table you can configure on an HP 9308M routing switch using a 128MB management module, enter commands such as the following at the global CONFIG level of the CLI:

```
HP9300(config)# system-max ip-static-arp 2048
HP9300(config)# write memory
HP9300(config)# end
HP9300# reload
```

Syntax: system-max ip-static-arp <num>

The <num> parameter indicates the maximum number of static ARP entries and can be a number in one of the following ranges, depending on the device you are configuring. Table 6.5 lists the default maximum and range of configurable maximums for static ARP table entries supported on each type of HP routing switch.

Table 6.5: Static ARP Entry Support

Product	Default Maximum	Configurable Minimum	Configurable Maximum
HP 9304M or HP 9308M with 128MB management module	1024	1024	2048
HP 9304M or HP 9308M with 32MB management module (Management I module)	512	512	1024
HP ProCurve 6308M-SX routing switch with 32MB memory	512	512	1024

USING THE WEB MANAGEMENT INTERFACE

To modify a table size using the Web management interface:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Select the Max-Parameter link to display the Configure System Parameter Maximum Value table. This table lists the settings and valid ranges for all the configurable table sizes on the device.
3. Click the Modify button next to the ip-static-arp row.

4. Enter the new value for the cache size. The value you enter specifies the maximum number of entries the cache can hold.
5. Click Apply to save the changes to the device's running-config.
6. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.
7. Click on the plus sign next to Command in the tree view to list the command options.
8. Select the Reload link and select Yes when the Web management interface asks you whether you really want to reload the software. Changes to cache and table sizes do not take effect until you reload the software.

Configuring Forwarding Parameters

The following configurable parameters control the forwarding behavior of HP routing switches:

- Time-To-Live (TTL) threshold
- Forwarding of directed broadcasts
- Forwarding of source-routed packets
- Ones-based and zero-based broadcasts

All these parameters are global and thus affect all IP interfaces configured on the routing switch.

To configure these parameters, use the procedures in the following sections.

Changing the TTL Threshold

The TTL threshold prevents routing loops by specifying the maximum number of router hops an IP packet originated by the routing switch can travel through. Each device capable of forwarding IP that receives the packet decrements (decreases) the packet's TTL by one. If a device receives a packet with a TTL of 1 and reduces the TTL to zero, the device drops the packet.

The default TTL is 64. You can change the TTL to a value from 1– 255.

To modify the TTL, use either of the following methods.

USING THE CLI

To modify the TTL threshold to 25, enter the following commands:

```
HP9300(config)# ip ttl 25
```

Syntax: ip ttl <1-255>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the list of configuration options.
3. Click on the plus sign next to IP to display the list of IP configuration options.
4. Select the General link to display the IP configuration panel.
5. Enter a value from 1 – 255 into the TTL field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Enabling Forwarding of Directed Broadcasts

A directed broadcast is an IP broadcast to all devices within a single directly-attached network or sub-net. A net-directed broadcast goes to all devices on a given network. A sub-net-directed broadcast goes to all devices within a given sub-net.

NOTE: A less common type, the all-sub-nets broadcast, goes to all directly-attached sub-nets. Forwarding for this broadcast type also is supported, but most networks use IP multicasting instead of all-sub-net broadcasting.

Forwarding for all types of IP directed broadcasts is disabled by default. You can enable forwarding for all types if needed. You cannot enable forwarding for specific broadcast types.

To enable forwarding of IP directed broadcasts, use either of the following methods.

USING THE CLI

```
HP9300(config)# ip directed-broadcast
```

Syntax: [no] ip directed-broadcast

HP software makes the forwarding decision based on the routing switch's knowledge of the destination network prefix. Routers cannot determine that a message is unicast or directed broadcast apart from the destination network prefix. The decision to forward or not forward the message is by definition only possible in the last hop router.

To disable the directed broadcasts, enter the following command in the CONFIG mode:

```
HP9300(config)# no ip directed-broadcast
```

To enable directed broadcasts on an individual interface instead of globally for all interfaces, enter commands such as the following:

```
HP9300(config)# interface ethernet 1/1
HP9300(config-if-1/1)# ip directed-broadcast
```

Syntax: [no] ip directed-broadcast

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the list of configuration options.
3. Click on the plus sign next to IP to display the list of IP configuration options.
4. Select the General link to display the IP configuration panel.
5. Select Enable or Disable next to Directed Broadcast Forward.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Disabling Forwarding of IP Source-Routed Packets

A source-routed packet specifies the exact router path for the packet. The packet specifies the path by listing the IP addresses of the router interfaces through which the packet must pass on its way to the destination. The routing switch supports both types of IP source routing:

- Strict source routing – requires the packet to pass through only the listed routers. If the routing switch receives a strict source-routed packet but cannot reach the next hop interface specified by the packet, the routing switch discards the packet and sends an ICMP Source-Route-Failure message to the sender.

  NOTE: The routing switch allows you to disable sending of the Source-Route-Failure messages. See "Disabling ICMP Messages" on page 6-34.

- Loose source routing – requires that the packet pass through all of the listed routers but also allows the packet to travel through other routers, which are not listed in the packet.

The routing switch forwards both types of source-routed packets by default. To disable the feature, use either of the following methods. You cannot enable or disable strict or loose source routing separately.

USING THE CLI

To disable forwarding of IP source-routed packets, enter the following command:

```
HP9300(config)# no ip source-route
```

Syntax: [no] ip source-route

To re-enable forwarding of source-routed packets, enter the following command:

```
HP9300(config)# ip source-route
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Select the Disable or Enable radio button next to Source Route.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Enabling Support for Zero-Based IP Sub-Net Broadcasts

By default, the routing switch treats IP packets with all ones in the host portion of the address as IP broadcast packets. For example, the routing switch treats IP packets with 209.157.22.255/24 as the destination IP address as IP broadcast packets and forwards the packets to all IP hosts within the 209.157.22.x sub-net (except the host that sent the broadcast packet to the routing switch).

Most IP hosts are configured to receive IP sub-net broadcast packets with all ones in the host portion of the address. However, some older IP hosts instead expect IP sub-net broadcast packets that have all zeros instead of all ones in the host portion of the address. To accommodate this type of host, you can enable the routing switch to treat IP packets with all zeros in the host portion of the destination IP address as broadcast packets.

NOTE: When you enable the routing switch for zero-based sub-net broadcasts, the routing switch still treats IP packets with all ones the host portion as IP sub-net broadcasts too. Thus, the routing switch can be configured to support all ones only (the default) or all ones ***and*** all zeroes.

NOTE: This feature applies only to IP sub-net broadcasts, not to local network broadcasts. The local network broadcast address is still expected to be all ones.

To enable the routing switch for zero-based IP broadcasts, use either of the following methods.

USING THE CLI

To enable the routing switch for zero-based IP sub-net broadcasts in addition to ones-based IP sub-net broadcasts, enter the following command.

```
HP9300(config)# ip broadcast-zero
```

Syntax: [no] ip broadcast-zero

USING THE WEB MANAGEMENT INTERFACE

You cannot enable zero-based IP sub-net broadcasting using the Web management interface.

Disabling ICMP Messages

HP devices are enabled to reply to ICMP echo messages and send ICMP Destination Unreachable messages by default.

You can selectively disable the following types of Internet Control Message Protocol (ICMP) messages:

- Echo messages (ping messages) – The routing switch replies to IP pings from other IP devices.
- Destination Unreachable messages – If the routing switch receives an IP packet that it cannot deliver to its destination, the routing switch discards the packet and sends a message back to the device that sent the packet to the routing switch. The message informs the device that the destination cannot be reached by the routing switch.

Disabling Replies to Broadcast Ping Requests

By default, HP devices are enabled to respond to broadcast ICMP echo packets, which are ping requests. You can disable response to ping requests on a global basis using the following CLI method.

USING THE CLI

To disable response to broadcast ICMP echo packets (ping requests), enter the following command:

```
HP9300(config)# no ip icmp echo broadcast-request
```

Syntax: [no] ip icmp echo broadcast-request

If you need to re-enable response to ping requests, enter the following command:

```
HP9300(config)# ip icmp echo broadcast-request
```

USING THE WEB MANAGEMENT INTERFACE

You cannot disable ICMP Echo replies using the Web management interface.

Disabling ICMP Destination Unreachable Messages

By default, when an HP device receives an IP packet that the device cannot deliver, the device sends an ICMP Unreachable message back to the host that sent the packet. You can selectively disable an HP device's response to the following types of ICMP Unreachable messages:

- Administration – The packet was dropped by the HP device due to a filter or ACL configured on the device.
- Fragmentation-needed – The packet has the Don't Fragment bit set in the IP Flag field, but the HP device cannot forward the packet without fragmenting it.
- Host – The destination network or sub-net of the packet is directly connected to the HP device, but the host specified in the destination IP address of the packet is not on the network.
- Network – The HP device cannot reach the network specified in the destination IP address of the packet.
- Port – The destination host does not have the destination TCP or UDP port specified in the packet. In this case, the host sends the ICMP Port Unreachable message to the HP device, which in turn sends the message to the host that sent the packet.
- Protocol – The TCP or UDP protocol on the destination host is not running. This message is different from the Port Unreachable message, which indicates that the protocol is running on the host but the requested protocol port is unavailable.
- Source-route-failure – The device received a source-routed packet but cannot locate the next-hop IP address indicated in the packet's Source-Route option.

You can disable the HP device from sending these types of ICMP messages on an individual basis. To do so, use the following CLI method.

NOTE: Disabling an ICMP Unreachable message type does not change the HP device's ability to forward packets. Disabling ICMP Unreachable messages prevents the device from generating or forwarding the Unreachable messages.

USING THE CLI

To disable all ICMP Unreachable messages, enter the following command:

```
HP9300(config)# no ip icmp unreachable
```

Syntax: [no] ip icmp unreachable [network | host | protocol | administration | fragmentation-needed | port | source-route-fail]

If you enter the command without specifying a message type (as in the example above), all types of ICMP Unreachable messages listed above are disabled. If you want to disable only specific types of ICMP Unreachable messages, you can specify the message type. To disable more than one type of ICMP message, enter the **no ip icmp unreachable** command for each messages type.

- The **network** parameter disables ICMP Network Unreachable messages.
- The **host** parameter disables ICMP Host Unreachable messages.
- The **protocol** parameter disables ICMP Protocol Unreachable messages.
- The **administration** parameter disables ICMP Unreachable (caused by Administration action) messages.
- The **fragmentation-needed** parameter disables ICMP Fragmentation-Needed But Don't-Fragment Bit Set messages.
- The **port** parameter disables ICMP Port Unreachable messages.
- The **source-route-fail** parameter disables ICMP Unreachable (caused by Source-Route-Failure) messages.

To disable ICMP Host Unreachable messages and ICMP Network Unreachable messages but leave the other types of ICMP Unreachable messages enabled, enter the following commands instead of the command shown above:

```
HP9300(config)# no ip icmp unreachable host
HP9300(config)# no ip icmp unreachable network
```

If you have disabled all ICMP Unreachable message types but you want to re-enable certain types, you can do so entering commands such as the following:

```
HP9300(config)# ip icmp unreachable host
HP9300(config)# ip icmp unreachable network
```

The commands shown above re-enable ICMP Unreachable Host messages and ICMP Network Unreachable messages.

USING THE WEB MANAGEMENT INTERFACE

You cannot disable ICMP Destination Unreachable messages using the Web management interface.

Disabling ICMP Redirects

You can disable ICMP redirects on a global basis or on an individual port basis. To disable ICMP redirects globally, enter the following command at the global CONFIG level of the CLI:

```
HP9300(config)# no ip icmp redirects
```

Syntax: [no] ip icmp redirects

To disable ICMP redirects on a specific interface, enter the same command at the configuration level for the interface:

```
HP9300(config)# int e 3/11
HP9300(config-if-e100-3/11)# no ip redirect
```

Syntax: [no] ip redirect

Configuring Static Routes

The IP route table can receive routes from the following sources:

- Directly-connected networks – When you add an IP interface, the routing switch automatically creates a route for the network the interface is in.
- RIP – If RIP is enabled, the routing switch can learn about routes from the advertisements other RIP routers send to the routing switch. If the route has a lower administrative distance than any other routes from different

sources to the same destination, the routing switch places the route in the IP route table.

- OSPF – See RIP, but substitute “OSPF” for “RIP”.
- BGP4 – See RIP, but substitute “BGP4” for “RIP”.
- Default network route – A statically configured default route that the routing switch uses if other default routes to the destination are not available. See “Configuring a Default Network Route” on page 6-46.
- Statically configured route – You can add routes directly to the route table. When you add a route to the IP route table, you are creating a static IP route. This section describes how to add static routes to the IP route table.

Static Route Types

You can configure the following types of static IP routes:

- Standard – the static route consists of the destination network address and network mask, and the IP address of the next-hop gateway. You can configure multiple standard static routes with the same metric for load sharing or with different metrics to provide a primary route and backup routes.
- Interface-based – the static route consists of the destination network address and network mask, and the routing switch interface through which you want the routing switch to send traffic for the route. Typically, this type of static route is for directly attached destination networks.
- Null – the static route consists of the destination network address and network mask, and the “null0” parameter. Typically, the null route is configured as a backup route for discarding traffic if the primary route is unavailable.

Static IP Route Parameters

When you configure a static IP route, you must specify the following parameters:

- The IP address and network mask for the route’s destination network.
- The route’s path, which can be one of the following:
  - The IP address of a next-hop gateway
  - An Ethernet port
  - A virtual interface (a routing interface used by VLANs for routing Layer 3 protocol traffic among one another)
  - A “null” interface. The routing switch drops traffic forwarded to the null interface.

You also can specify the following optional parameters:

- The route’s metric – The value the routing switch uses when comparing this route to other routes in the IP route table to the same destination. The metric applies only to routes that the routing switch has already placed in the IP route table. The default metric for static IP routes is 1.
- The route’s administrative distance – The value that the routing switch uses to compare this route with routes from other route sources to the same destination before placing a route in the IP route table. This parameter does not apply to routes that are already in the IP route table. The default administrative distance for static IP routes is 1.

The default metric and administrative distance values ensure that the routing switch always prefers static IP routes over routes from other sources to the same destination.

Multiple Static Routes to the Same Destination Provide Load Sharing and Redundancy

You can add multiple static routes for the same destination network to provide one or more of the following benefits:

- IP load balancing – When you add multiple IP static routes for the same destination to different next-hop gateways, and the routes each have the same metric and administrative distance, the routing switch can load balance traffic to the routes’ destination. For information about IP load balancing, see “Configuring IP Load Sharing” on page 6-48.

- Path redundancy – When you add multiple static IP routes for the same destination, but give the routes different metrics or administrative distances, the routing switch uses the route with the lowest administrative distance by default, but uses another route to the same destination of the first route becomes unavailable.

See the following sections for examples and configuration information:

- “Configuring Load Balancing and Redundancy Using Multiple Static Routes to the Same Destination” on page 6-41
- “Configuring Standard Static IP Routes and Interface or Null Static Routes to the Same Destination” on page 6-43

Static Route States Follow Port States

IP static routes remain in the IP route table only so long as the next-hop gateway, port, or virtual interface used by the route is available. If the gateway or port becomes unavailable, the software removes the static route from the IP route table. If the gateway or port later becomes available again, the software adds the route back to the route table.

This feature allows the routing switch to adjust to changes in network topology. The routing switch does not continue trying to use routes on unavailable paths but instead uses routes only when their paths are available.

Figure 6.2 shows an example of a network containing a static route. The static route is configured on Router A, as shown in the CLI example following the figure.

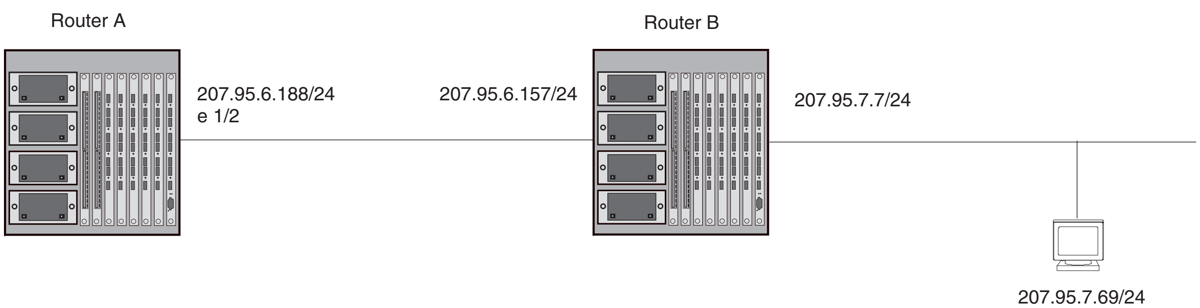


Figure 6.2 Example of a static route

The following command configures a static route to 207.95.7.0, using 207.95.6.157 as the next-hop gateway.

```
HP9300(config)# ip route 207.95.7.0/24 207.95.6.157
```

When you configure a static IP route, you specify the destination address for the route and the next-hop gateway or routing switch interface through which the routing switch can reach the route. The routing switch adds the route to the IP route table. In this case, Router A knows that 207.95.6.157 is reachable through port 1/2, and also assumes that local interfaces within that sub-net are on the same port. Router A deduces that IP interface 207.95.7.188 is also on port 1/2.

The software automatically removes a static IP route from the IP route table if the port used by that route becomes unavailable. When the port becomes available again, the software automatically re-adds the route to the IP route table.

Configuring a Static IP Route

To configure an IP static route, use either of the following methods.

USING THE CLI

To configure an IP static route with a destination address of 192.0.0.0 255.0.0.0 and a next-hop router IP address of 195.1.1.1, enter the following commands:

```
HP9300(config)# ip route 192.0.0.0 255.0.0.0 195.1.1.1
```

To configure a static IP route with an Ethernet port instead of a next-hop address, enter a command such as the following.

```
HP9300(config)# ip route 192.128.2.69 255.255.255.0 ethernet 4/1
```

The command in the example above configures a static IP route for destination network 192.128.2.69/24. Since an Ethernet port is specified instead of a gateway IP address as the next hop, the routing switch always forwards traffic for the 192.128.2.69/24 network to port 4/1. The command in the following example configures an IP static route that uses virtual interface 3 as its next hop.

```
HP9300(config)# ip route 192.128.2.71 255.255.255.0 ve 3
```

Syntax: ip route <dest-ip-addr> <dest-mask>
<next-hop-ip-addr> |
ethernet <portnum> | ve <num>
[<metric>] [distance <num>]

or

Syntax: ip route <dest-ip-addr>/<mask-bits>
<next-hop-ip-addr> |
ethernet <portnum> | ve <num>
[<metric>] [distance <num>]

The <dest-ip-addr> is the route's destination. The <dest-mask> is the network mask for the route's destination IP address. Alternatively, you can specify the network mask information by entering a forward slash followed by the number of bits in the network mask. For example, you can enter 192.0.0.0 255.255.255.0 as 192.0.0.0/.24.

The <next-hop-ip-addr> is the IP address of the next-hop router (gateway) for the route.

If you do not want to specify a next-hop IP address, you can instead specify a port or interface number on the routing switch. The <num> parameter is a virtual interface number. If you instead specify an Ethernet port, the <portnum> is the port's number (including the slot number, if you are configuring an HP 9304M or HP 9308M). In this case, the routing switch forwards packets destined for the static route's destination network to the specified interface. Conceptually, this feature makes the destination network like a directly connected network, associated with a specific routing switch interface.

NOTE: The port or virtual interface you use for the static route's next hop must have at least one IP address configured on it. The address does not need to be in the same sub-net as the destination network.

The <metric> parameter can be a number from 1 – 16. The default is 1.

NOTE: If you specify 16, RIP considers the metric to be infinite and thus also considers the route to be unreachable.

The **distance** <num> parameter specifies the administrative distance of the route. When comparing otherwise equal routes to a destination, the routing switch prefers lower administrative distances over higher ones, so make sure you use a low value for your default route. The default is 1.

NOTE: The routing switch will replace the static route if the routing switch receives a route with a lower administrative distance. See "Changing Administrative Distances" on page 10-30 for a list of the default administrative distances for all types of routes.

NOTE: You can also assign the default router as the destination by entering 0.0.0.0 0.0.0.0.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.

4. Click on the General link to display the IP configuration panel.
5. Click the Static Route link.
   - If the device does not have any IP static routes, the Static Route configuration panel is displayed.
   - If a static route is already configured and you are adding a new route, click on the Add Static Route link to display the Static Route configuration panel.
   - If you are modifying an existing static route, click on the Modify button to the right of the row describing the static route to display the Static Route configuration panel.
6. Enter the network address for the route in the Network field.
7. Enter the network mask in the Mask field.
8. Select the next-hop type. You can select one of the following:
   - Address – The next-hop is the IP address of a gateway router.
   - Interface – The next hop is a port, loopback interface, or virtual interface on the routing switch.
9. Enter the next-hop IP address (if you selected the Address method) or select the interface (if you selected the Interface method).
   - Address – Enter the IP address of the next-hop gateway in the Next Hop (by Address) field.
   - Interface – Select the port, loopback interface, or virtual interface from the Next Hop (by Interface) field's pulldown menu(s). Loopback interfaces and virtual interfaces are listed in the Port pulldown menu, not in the Slot pulldown menu. To select a loopback interface or a virtual interface on a Chassis device, ignore the Slot pulldown menu and select the interface from the Port pulldown menu.
10. Optionally change the metric by editing the value in the Metric field. You can specify a number from 1 – 16. The default is 1.

NOTE: If you specify 16, RIP considers the metric to be infinite and thus also considers the route to be unreachable.

11. Optionally change the administrative distance by editing the value in the Distance field. When comparing otherwise equal routes to a destination, the routing switch prefers lower administrative distances over higher ones, so make sure you use a low value for your default route. The default is 1.
12. Click the Add button to save the change to the device's running-config file.
13. Repeat steps 8 – 12 for each static route to the same destination.
14. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring a "Null" Route

You can configure the routing switch to drop IP packets to a specific network or host address by configuring a "null" (sometimes called "null0") static route for the address. When the routing switch receives a packet destined for the address, the routing switch drops the packet instead of forwarding it.

To configure a null static route, use the following CLI method.

USING THE CLI

To configure a null static route to drop packets destined for network 209.157.22.x, enter the following commands.

```
HP9300(config)# ip route 209.157.22.0 255.255.255.0 null0
HP9300(config)# write memory
```

Syntax: ip route <ip-addr> <ip-mask> null0 [<metric>] [distance <num>]

or

Syntax: ip route <ip-addr>/<mask-bits> null0 [<metric>] [distance <num>]

To display the maximum value for your device, enter the **show default values** command. The maximum number of static IP routes the system can hold is listed in the ip-static-route row in the System Parameters section of the display. To change the maximum value, use the **system-max ip-static-route** <num> command at the global CONFIG level.

The <ip-addr> parameter specifies the network or host address. The routing switch will drop packets that contain this address in the destination field instead of forwarding them.

The <ip-mask> parameter specifies the network mask. Ones are significant bits and zeros allow any value. For example, the mask 255.255.255.0 matches on all hosts within the Class C sub-net address specified by <ip-addr>. Alternatively, you can specify the number of bits in the network mask. For example, you can enter 209.157.22.0/24 instead of 209.157.22.0 255.255.255.0.

The **null0** parameter indicates that this is a null route. You must specify this parameter to make this a null route.

The <metric> parameter adds a cost to the route. You can specify from 1 – 16. The default is 1.

The distance <num> parameter configures the administrative distance for the route. You can specify a value from 1 – 255. The default is 1. The value 255 makes the route unusable.

NOTE: The last two parameters are optional and do not affect the null route, unless you configure the administrative distance to be 255. In this case, the route is not used and the traffic might be forwarded instead of dropped.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure a null IP static route using the Web management interface.

Configuring Load Balancing and Redundancy Using Multiple Static Routes to the Same Destination

You can configure multiple static IP routes to the same destination, for the following benefits:

- IP load sharing – If you configure more than one static route to the same destination, and the routes have different next-hop gateways but have the same metrics, the routing switch load balances among the routes using basic round-robin. For example, if you configure two static routes with the same metrics but to different gateways, the routing switch alternates between the two routes. For information about IP load balancing, see “Configuring IP Load Sharing” on page 6-48.
- Backup Routes – If you configure multiple static IP routes to the same destination, but give the routes different next-hop gateways and different metrics, the routing switch will always use the route with the lowest metric. If this route becomes unavailable, the routing switch will fail over to the static route with the next-lowest metric, and so on.

NOTE: You also can bias the routing switch to select one of the routes by configuring them with different administrative distances. However, make sure you do not give a static route a higher administrative distance than other types of routes, unless you want those other types to be preferred over the static route. For a list of the default administrative distances, see “Changing Administrative Distances” on page 10-30.

The steps for configuring the static routes are the same as described in the previous section. The following sections provide examples.

USING THE CLI

To configure multiple static IP routes, enter commands such as the following.

```
HP9300(config)# ip route 192.128.2.69 255.255.255.0 209.157.22.1
HP9300(config)# ip route 192.128.2.69 255.255.255.0 192.111.10.1
```

The commands in the example above configure two static IP routes. The routes go to different next-hop gateways but have the same metrics. These commands use the default metric value (1), so the metric is not specified. These static routes are used for load sharing among the next-hop gateways.

The following commands configure static IP routes to the same destination, but with different metrics. The route with the lowest metric is used by default. The other routes are backups in case the first route becomes unavailable. The routing switch uses the route with the lowest metric if the route is available.

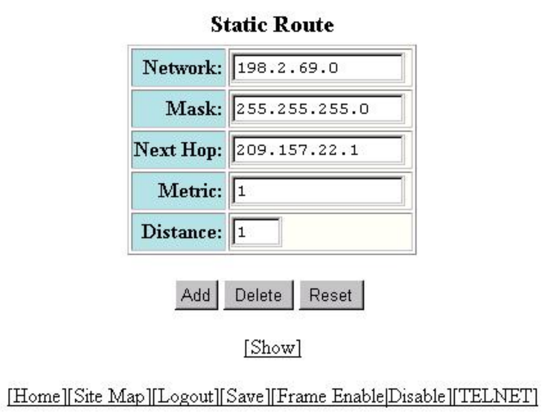
```
HP9300(config)# ip route 192.128.2.69 255.255.255.0 209.157.22.1
HP9300(config)# ip route 192.128.2.69 255.255.255.0 192.111.10.1 2
HP9300(config)# ip route 192.128.2.69 255.255.255.0 201.1.1.1 3
```

In this example, each static route has a different metric. The metric is not specified for the first route, so the default (1) is used. A metric is specified for the second and third static IP routes. The second route has a metric of two and the third route has a metric of 3. Thus, the second route is used only of the first route (which has a metric of 1) becomes unavailable. Likewise, the third route is used only if the first and second routes (which have lower metrics) are both unavailable.

For complete syntax information, see “Configuring a Static IP Route” on page 6-38.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Click the Static Route link.
    - If the device does not have any IP static routes, the Static Route configuration panel is displayed, as shown in the following example.
    - If a static route is already configured and you are adding a new route, click on the Add Static Route link to display the Static Route configuration panel, as shown in the following example.
    - If you are modifying an existing static route, click on the Modify button to the right of the row describing the static route to display the Static Route configuration panel, as shown in the following example.



6. Enter the network address for the route in the Network field.
7. Enter the network mask in the Mask field.
8. Enter the IP address of the next hop gateway in the Next Hop field.
9. Optionally change the metric by editing the value in the Metric field. You can specify a number from 1 – 16. The default is 1.

NOTE: If you specify 16, RIP considers the metric to be infinite and thus also considers the route to be unreachable.

10. Optionally change the administrative distance by editing the value in the Distance field. When comparing otherwise equal routes to a destination, the routing switch prefers lower administrative distances over higher ones, so make sure you use a low value for your default route. The default is 1.
11. Click the Add button to save the change to the device's running-config file.
12. Repeat steps 8 – 11 for each static route to the same destination.
13. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring Standard Static IP Routes and Interface or Null Static Routes to the Same Destination

You can configure a null0 or interface-based static route to a destination and also configure a normal static route to the same destination, so long as the route metrics are different.

When the routing switch has multiple routes to the same destination, the routing switch always prefers the route with the lowest metric. Generally, when you configure a static route to a destination network, you assign the route a low metric so that the routing switch prefers the static route over other routes to the destination.

This feature is especially useful for the following configurations. These are not the only allowed configurations but they are typical uses of this enhancement.

- When you want to ensure that if a given destination network is unavailable, the routing switch drops (forwards to the null interface) traffic for that network instead of using alternate paths to route the traffic. In this case, assign the normal static route to the destination network a lower metric than the null route.
- When you want to use a specific interface by default to route traffic to a given destination network, but want to allow the routing switch to use other interfaces to reach the destination network if the path that uses the default interface becomes unavailable. In this case, give the interface route a lower metric than the normal static route.

NOTE: You cannot add a null or interface-based static route to a network if there is already a static route of any type with the same metric you specify for the null or interface-based route.

Figure 6.3 shows an example of two static routes configured for the same destination network. In this example, one of the routes is a standard static route and has a metric of 1. The other static route is a null route and has a higher metric than the standard static route. The routing switch always prefers the static route with the lower metric. In this example, the routing switch always uses the standard static route for traffic to destination network 192.168.7.0/24, unless that route becomes unavailable, in which case the routing switch sends traffic to the null route instead.

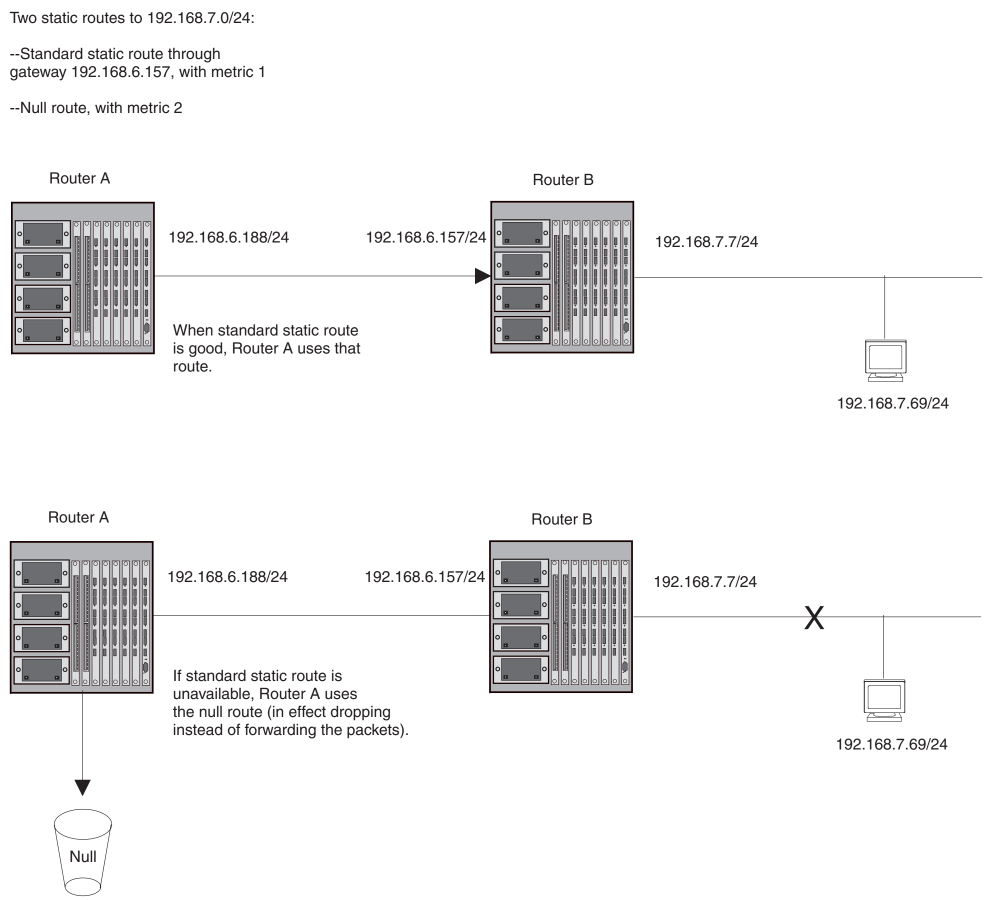


Figure 6.3 Standard and null static routes to the same destination network

Figure 6.4 shows another example of two static routes. In this example, a standard static route and an interface-based static route are configured for destination network 192.168.6.0/24. The interface-based static route has a lower metric than the standard static route. As a result, the routing switch always prefers the interface-based route when the route is available. However, if the interface-based route becomes unavailable, the routing switch still forwards the traffic toward the destination using an alternate route through gateway 192.168.8.11/24.

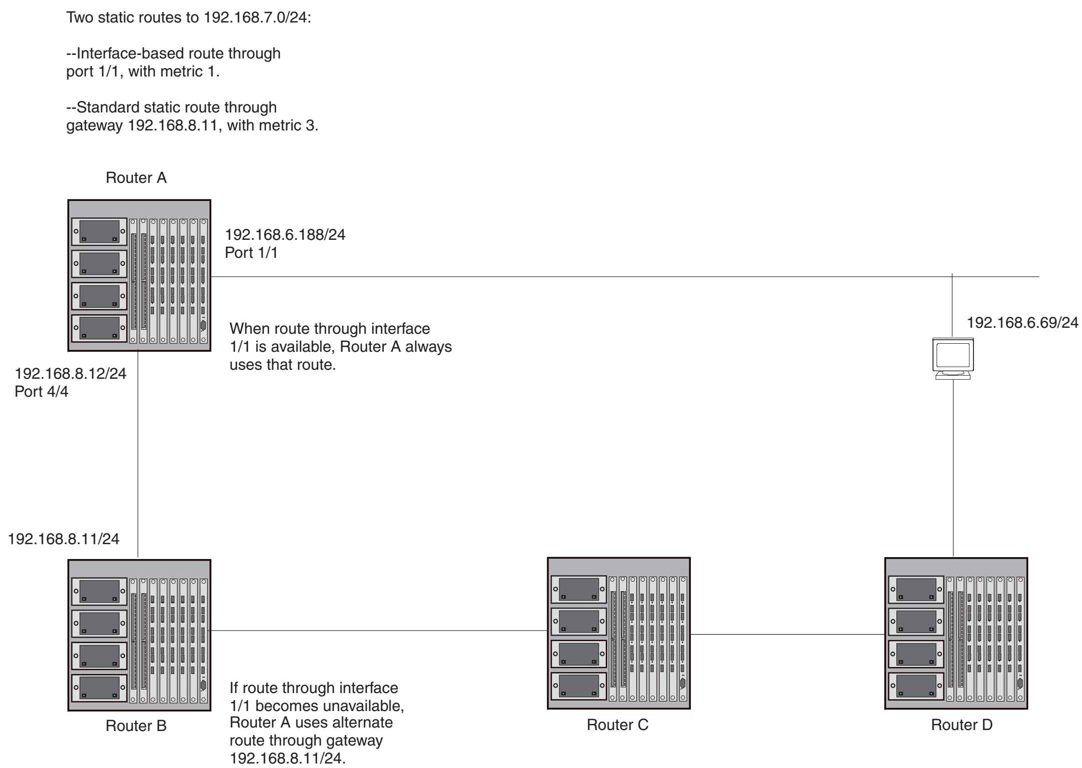


Figure 6.4 Standard and interface routes to the same destination network

To configure the multiple static routes of different types to the same destination, use either of the following methods.

USING THE CLI

To configure a standard static IP route and a null route to the same network as shown in Figure 6.3 on page 6-44, enter commands such as the following:

```
HP9300(config)# ip route 192.168.7.0/24 192.168.6.157/24 1
HP9300(config)# ip route 192.168.7.0/24 null0 3
```

The first command configures a standard static route, which includes specification of the next-hop gateway. The command also gives the standard static route a metric of 1, which causes the routing switch to always prefer this route when the route is available.

The second command configures another static route for the same destination network, but the second route is a null route. The metric for the null route is 3, which is higher than the metric for the standard static route. If the standard static route is unavailable, the software uses the null route.

For complete syntax information, see “Configuring a Static IP Route” on page 6-38.

To configure a standard static route and an interface-based route to the same destination, enter commands such as the following:

```
HP9300(config)# ip route 192.168.6.0/24 ethernet 1/1 1
HP9300(config)# ip route 192.168.6.0/24 192.168.8.11/24 3
```

The first command configured an interface-based static route through Ethernet port 1/1. The command assigns a metric of 1 to this route, causing the routing switch to always prefer this route when it is available. If the route becomes unavailable, the routing switch uses an alternate route through the next-hop gateway 192.168.8.11/24.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Click the Static Route link.
   - If the device does not have any IP static routes, the Static Route configuration panel is displayed.
   - If a static route is already configured and you are adding a new route, click on the Add Static Route link to display the Static Route configuration panel.
   - If you are modifying an existing static route, click on the Modify button to the right of the row describing the static route to display the Static Route configuration panel.
6. Enter the network address for the route in the Network field.
7. Enter the network mask in the Mask field.
8. Select the next-hop type. You can select one of the following:
   - Address – The next-hop is the IP address of a gateway router.
   - Interface – The next hop is a port, loopback interface, or virtual interface on the routing switch.
9. Enter the next-hop IP address (if you selected the Address method) or select the interface (if you selected the Interface method).
   - Address – Enter the IP address of the next-hop gateway in the Next Hop (by Address) field.
   - Interface – Select the port, loopback interface, or virtual interface from the Next Hop (by Interface) field's pulldown menu(s). Loopback interfaces and virtual interfaces are listed in the Port pulldown menu, not in the Slot pulldown menu. To select a loopback interface or a virtual interface on a Chassis device, ignore the Slot pulldown menu and select the interface from the Port pulldown menu.

NOTE: You cannot configure a null IP static route using the Web management interface.

10. Optionally change the metric by editing the value in the Metric field. You can specify a number from 1 – 16. The default is 1.

NOTE: If you specify 16, RIP considers the metric to be infinite and thus also considers the route to be unreachable.

11. Optionally change the administrative distance by editing the value in the Distance field. When comparing otherwise equal routes to a destination, the routing switch prefers lower administrative distances over higher ones, so make sure you use a low value for your default route. The default is 1.
12. Click the Add button to save the change to the device's running-config file.
13. Repeat steps 8 – 12 for each static route to the same destination.
14. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring a Default Network Route

The routing switch enables you to specify a candidate default route without the need to specify the next hop gateway. If the IP route table does not contain an explicit default route (for example, 0.0.0.0/0) or propagate an explicit default route through routing protocols, the software can use the default network route as a default route instead.

When the software uses the default network route, it also uses the default network route's next hop gateway as the gateway of last resort.

This feature is especially useful in environments where network topology changes can make the next hop gateway unreachable. This feature allows the routing switch to perform default routing even if the default network route's default gateway changes.

The feature thus differs from standard default routes. When you configure a standard default route, you also specify the next hop gateway. If a topology change makes the gateway unreachable, the default route becomes unusable.

For example, if you configure 10.10.10.0/24 as a candidate default network route, if the IP route table does not contain an explicit default route (0.0.0.0/0), the software uses the default network route and automatically uses that route's next hop gateway as the default gateway. If a topology change occurs and as a result the default network route's next hop gateway changes, the software can still use the default network route. To configure a default network route, use the following CLI method.

If you configure more than one default network route, the routing switch uses the following algorithm to select one of the routes:

1. Use the route with the lowest administrative distance.
2. If the administrative distances are equal:
   - Are the routes from different routing protocols (RIP, OSPF, or BGP4)? If so, use the route with the lowest IP address.
   - If the routes are from the same routing protocol, use the route with the best metric. The meaning of "best" metric depends on the routing protocol:
   - RIP – The metric is the number of hops (additional routers) to the destination. The best route is the route with the fewest hops.
   - OSPF – The metric is the path cost associated with the route. The path cost does not indicate the number of hops but is instead a numeric value associated with each route. The best route is the route with the lowest path cost.
   - BGP4 – The metric is the Multi-exit Discriminator (MED) associated with the route. The MED applies to routes that have multiple paths through the same AS. The best route is the route with the lowest MED.

Configuring a Default Network Route

To configure a default network route, use one of the following methods. You can configure up to four default network routes.

USING THE CLI

To configure a default network route, enter commands such as the following:

```
HP9300(config)# ip default-network 209.157.22.0
HP9300(config)# write memory
```

Syntax: ip default-network <ip-addr>

The <ip-addr> parameter specifies the network address.

To verify that the route is in the route table, enter the following command at any level of the CLI:

```
HP9300(config)# show ip route

Total number of IP routes: 2
Start index: 1  B:BGP D:Connected  R:RIP  S:Static  O:OSPF *:Candidate default
      Destination       NetMask           Gateway           Port   Cost   Type
1     209.157.20.0      255.255.255.0     0.0.0.0           lb1    1      D
2     209.157.22.0      255.255.255.0     0.0.0.0           4/11   1      *D
```

This example shows two routes. Both of the routes are directly attached, as indicated in the Type column. However, one of the routes is shown as type "*D", with an asterisk (*). The asterisk indicates that this route is a candidate default network route.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure a default network route using the Web management interface. In addition, the IP route table display in the Web management interface does not indicate routes that are candidate default network routes. The routes are listed but are not flagged with an asterisk.

Configuring IP Load Sharing

The IP route table can contain more than one path to a given destination. When this occurs, the routing switch selects the path with the lowest cost as the path for forwarding traffic to the destination. If the IP route table contains more than one path to a destination and the paths each have the lowest cost, then the routing switch uses ***IP load sharing*** to select a path to the destination.[1]

IP load sharing is based on the destination address of the traffic. Chassis routing switches support load sharing based on individual host addresses or on network addresses. The HP 6308M-SX routing switch supports load sharing based on host addresses.

You can enable a routing switch to load balance across up to eight equal-cost paths. The default maximum number of equal-cost load sharing paths is four.

NOTE: IP load sharing is not based on source routing, only on next-hop routing.

NOTE: The term “path” refers to the next-hop router to a destination, not to the entire route to a destination. Thus, when the software compares multiple equal-cost paths, the software is comparing paths that use different next-hop routers, with equal costs, to the same destination.

In many contexts, the terms “route” and ”path” mean the same thing. Most of the user documentation uses the term “route” throughout. The term “path” is used in this section to refer to an individual next-hop router to a destination, while the term “route” refers collectively to the multiple paths to the destination. Load sharing applies when the IP route table contains multiple, equal-cost paths to a destination.

How Multiple Equal-Cost Paths Enter the IP Route Table

IP load sharing applies to equal-cost paths in the IP route table. Routes that are eligible for load sharing can enter the table from any of the following sources:

- IP static routes
- Routes learned through RIP
- Routes learned through OSPF
- Routes learned through BGP4

Administrative Distance

The administrative distance is a unique value associated with each type (source) of IP route. Each path has an administrative distance. The administrative distance is not used when performing IP load sharing, but the administrative distance is used when evaluating multiple equal-cost paths to the same destination from different sources, such as RIP, OSPF and so on.

The value of the administrative distance is determined by the source of the route. The routing switch is configured with a unique administrative distance value for each IP route source.

When the software receives multiple paths to the same destination and the paths are from different sources, the software compares the administrative distances of the paths and selects the path with the lowest distance. The software then places the path with the lowest administrative distance in the IP route table. For example, if the routing switch has a path learned from OSPF and a path learned from RIP for a given destination, only the path with the lower administrative distance enters the IP route table.

1.IP load sharing is also called “Equal-Cost Multi-Path (ECMP)” load sharing or just “ECMP”

Here are the default administrative distances on the HP routing switch:

- Directly connected – 0 (this value is not configurable)
- Static IP route – 1 (applies to all static routes, including default routes and default network routes)
- Exterior Border Gateway Protocol (EBGP) – 20
- OSPF – 110
- RIP – 120
- Interior Gateway Protocol (IBGP) – 200
- Local BGP – 200
- Unknown – 255 (the routing switch will not use this route)

Lower administrative distances are preferred over higher distances. For example, if the routing switch receives routes for the same network from OSPF and from RIP, the routing switch will prefer the OSPF route by default.

NOTE: You can change the administrative distances individually. See the configuration chapter for the route source for information.

Since the software selects only the path with the lowest administrative distance, and the administrative distance is determined by the path's source, IP load sharing does not apply to paths from different route sources. IP load sharing applies only when the IP route table contains multiple paths to the same destination, from the same IP route source.

IP load sharing does not apply to paths that come from different sources.

Path Cost

The cost parameter provides a common basis of comparison for selecting from among multiple paths to a given destination. Each path in the IP route table has a cost. When the IP route table contains multiple paths to a destination, the routing switch chooses the path with the lowest cost. When the IP route table contains more than one path with the lowest cost to a destination, the routing switch uses IP load sharing to select one of the lowest-cost paths.

The source of a path's cost value depends on the source of the path.

- IP static route – The value you assign to the metric parameter when you configure the route. The default metric is 1. See "Configuring Load Balancing and Redundancy Using Multiple Static Routes to the Same Destination" on page 6-41.
- RIP – The number of next-hop routers to the destination.
- OSPF – The Path Cost associated with the path. The paths can come from any combination of inter-area, intra-area, and external Link State Advertisements (LSAs).
- BGP4 – The path's Multi-Exit Discriminator (MED) value.

NOTE: If the path is redistributed between two or more of the above sources before entering the IP route table, the cost can increase during the redistribution due to settings in redistribution filters.

Static Route, OSPF, and BGP4 Load Sharing

IP load sharing and load sharing for static routes, OSPF routes, and BGP4 routes are individually configured. Multiple equal-cost paths for a destination can enter the IP route table only if the source of the paths is configured to support multiple equal-cost paths. For example, if BGP4 allows only one path with a given cost for a given destination, the BGP4 route table cannot contain equal-cost paths to the destination. Consequently, the IP route table will not receive multiple equal-cost paths from BGP4.

Table 6.6 lists the default and configurable maximum numbers of paths for each IP route source that can provide equal-cost paths to the IP route table. The table also lists where to find configuration information for the route source's load sharing parameters.

The load sharing state for all the route sources is based on the state of IP load sharing. Since IP load sharing is enabled by default on all HP routing switches, load sharing for static IP routes, RIP routes, OSPF routes, and BGP4 routes also is enabled by default.

Table 6.6: Default Load Sharing Parameters for Route Sources

Route Source	Default Maximum Number of Paths	Maximum Number of Paths	See...
Static IP route	4[a]	8[a]	6-59
RIP	4[a]	8[a]	6-59
OSPF	4	8	6-59
BGP4	1	4	10-25

a.This value depends on the value for IP load sharing, and is not separately configurable.

How IP Load Sharing Works

When the routing switch receives traffic for a destination and the IP route table contains multiple, equal-cost paths to that destination, the device checks the IP forwarding cache for a forwarding entry for the destination. The IP forwarding cache provides fast path for forwarding IP traffic, including load-balanced traffic. The cache contains entries that associate a destination host or network with a path (next-hop router).

- If the IP forwarding sharing cache contains a forwarding entry for the destination, the device uses the entry to forward the traffic.
- If the IP load forwarding cache does not contain a forwarding entry for the destination, the software selects a path from among the available equal-cost paths to the destination, then creates a forwarding entry in the cache based on the calculation. Subsequent traffic for the same destination uses the forwarding entry.

HP routing switches support the following IP load sharing methods:

- Host-based – The routing switch uses a simple round-robin mechanism to distribute traffic across the equal-cost paths based on destination host IP address. This is the only method supported by the HP 6308M-SX routing switch. This method is an option on chassis routing switches.
- Network-based – The routing switch distributes traffic across equal-cost paths based on destination network address. The software selects a path based on a calculation involving the maximum number of load-sharing paths allowed and the actual number of paths to the destination network. This method is available only on chassis routing switches and is the default.

In addition, on chassis routing switches you can use network-based load sharing as the default while configuring host-based load sharing for specific destination networks. When you configure host-based load sharing for a specific destination network, the routing switch distributes traffic to hosts on the network evenly across the available paths. For other networks, the routing switch uses a single path for all traffic to hosts on a given network.

NOTE: Regardless of the method of load sharing that is enabled, the routing switch always load shares paths for default routes and the network default route based on destination host address.

Path Redundancy

If a path to a given destination becomes unavailable, the routing switch provides redundancy by using another available equal-cost path to the destination, as described in the following sections.

Response to Path State Changes

If one of the load-balanced paths to a cached destination becomes unavailable, or the IP route table receives a new equal-cost path to a cached destination, the software removes the unavailable path from the IP route table. Then the software selects a new path:

- For host-based IP load sharing, the next load-balancing cache entry uses the first path to the destination. The first path is the path that entered the IP route table first. "Host-Based IP Load Sharing" on page 6-51 describes the host-based load-sharing mechanism.
- For network-based IP load sharing, the next load-balancing cache entry uses the next available path is then calculated based on the current number of paths and the maximum number of paths allowed. "Network-Based IP Load Sharing" on page 6-53 describes the network-based load-sharing mechanism.

Host-Based IP Load Sharing

The host-based load sharing method uses a simple round-robin mechanism to select an equal-cost path for traffic to a destination host. When the routing switch receives traffic for a destination host and the IP route table has multiple equal-cost paths to the host, the routing switch checks the IP forwarding cache for a forwarding entry to the destination.

- If the IP forwarding cache contains a forwarding entry for the destination, the device uses the entry to forward the traffic.
- If the IP forwarding cache does not contain a forwarding entry for the destination, the software selects the next path in the rotation (the path after the one the software used for the previous load sharing selection). The software then creates an IP forwarding cache entry that associates the destination host IP address with the selected path (next-hop IP address).

A cache entry for host-based IP load sharing has an age time of ten minutes. If a cache entry is not used before the age time expires, the device deletes the cache entry. The age time for IP load sharing cache entries is not configurable.

Figure 6.5 shows an example of host-based IP load sharing. In this example, the routing switch has two equal-cost paths to hosts H1 – H9. For simplicity, this example assumes that the routing switch does not have any entries in its IP forwarding cache to begin with, and receives traffic for the destination hosts (H1 – H9) in ascending numerical order, beginning with H1 and ending with H9.

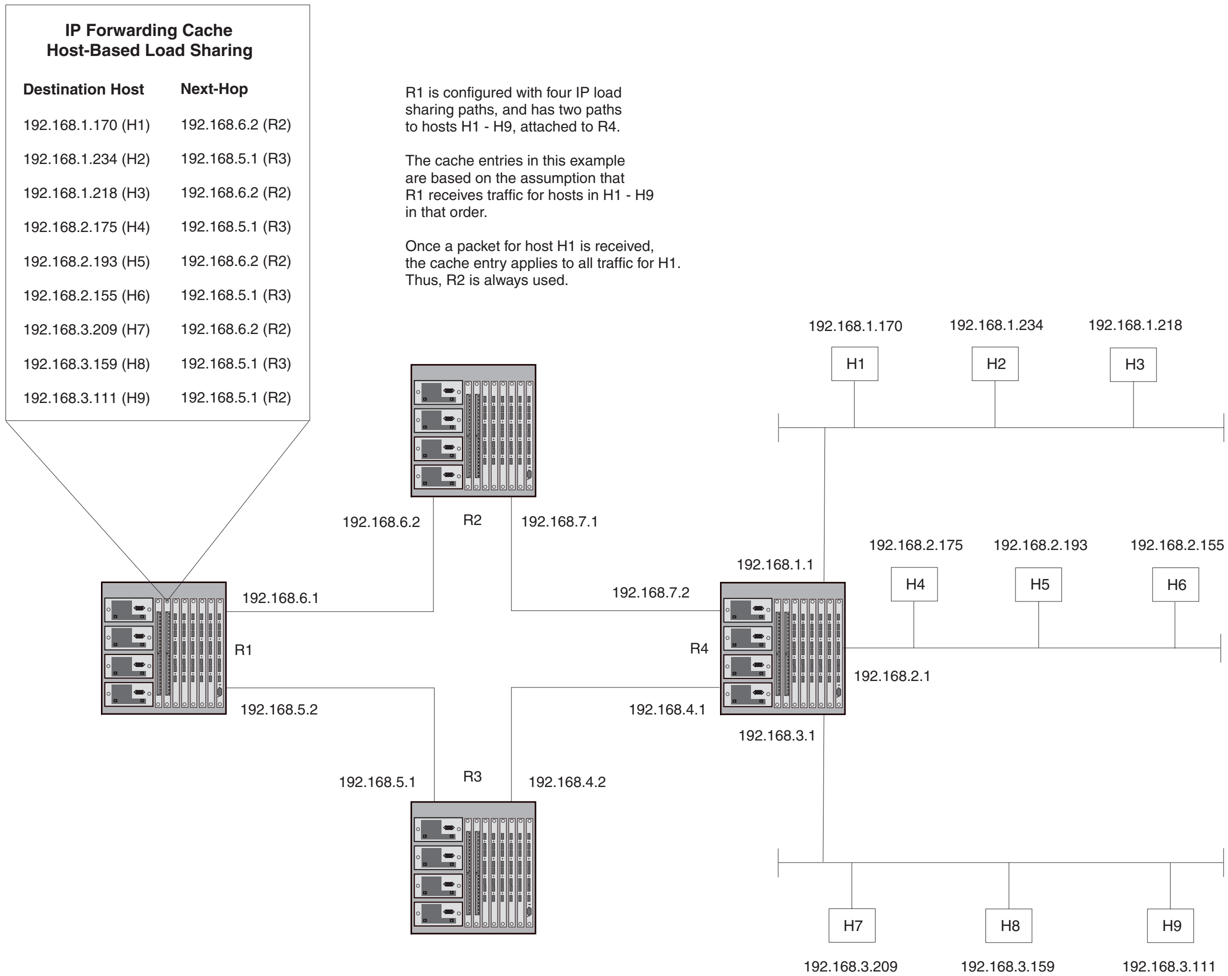


Figure 6.5 Host-based IP load sharing – basic example

As shown in this example, when the routing switch receives traffic for a destination and the IP route table has multiple equal-cost paths to that destination, the routing switch selects the next equal-cost path (next-hop router) in the rotation and assigns that path to destination. The path rotation is determined by the order in which the IP route table receives the paths.

Since the configuration in this example contains two paths to hosts H1 – H9, the software alternates between the two paths when creating new load sharing cache entries for hosts H1 – H9. So long as the cache entry for a destination remains in the cache, the routing switch always uses the same path for the traffic to the destination. In this example, the routing switch always uses R2 as the next hop for forwarding traffic to H1.

Figure 6.6 shows another example of IP forwarding cache entries for the configuration shown in Figure 6.5. The network and load sharing configurations are the same, but the order in which R1 receives traffic for the host is different. The paths differ due to the order in which the routing switch receives the traffic for the destination hosts.

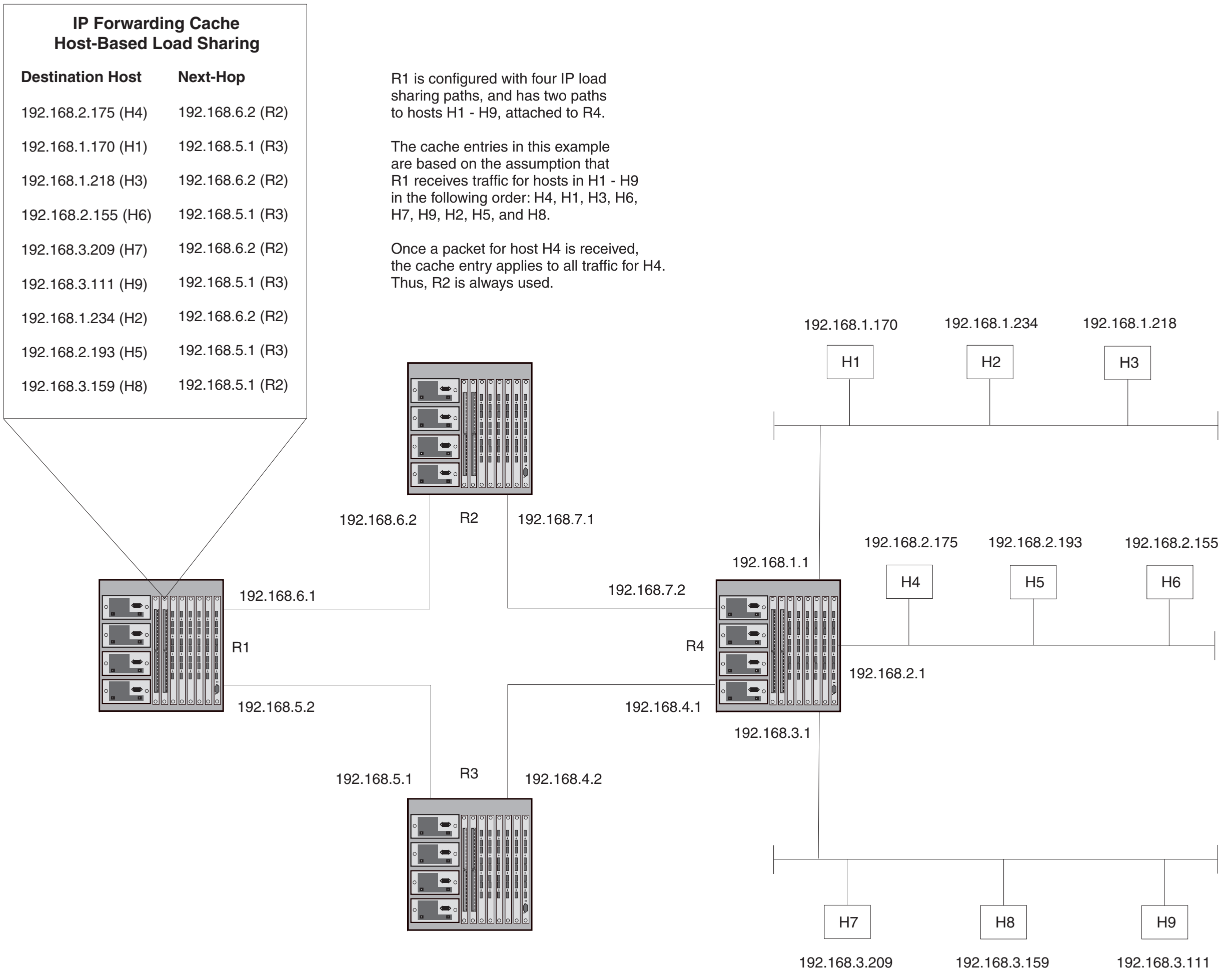


Figure 6.6 Host-based IP load sharing – additional example

Network-Based IP Load Sharing

Network-based load sharing distributes traffic across multiple equal-cost paths based on the destination network. This method of load sharing optimizes system resources by aggregating the forwarding cache entries used for load sharing. Host-based load sharing contains a separate cache entry for each destination host, whereas network-based load sharing contains a single entry for each destination network.

The network-based load sharing method is available only on chassis routing switches and is the default.

When the routing switch receives traffic for a device on a destination network for which the IP route table has multiple equal-cost paths, the routing switch checks the IP forwarding cache for a forwarding entry to the destination network:

- If the IP forwarding cache contains a forwarding entry for the destination network, the device uses the entry to forward the traffic.
- If the IP forwarding cache does not contain a forwarding entry for the destination network, the software selects the next path in the rotation (the path after the one the software used for the previous load sharing selection). The software then creates an IP forwarding cache entry that associates the destination network address with the selected path. IP forwarding cache entries for network-based load sharing do not age out. Once the software creates a cache entry for a destination network, traffic for all hosts on the network uses the same path. The cache entries remain in effect until the state of one of the paths changes or the software is reloaded.

Figure 6.7 shows an example of IP load sharing cache entries for network-based IP load sharing. The network in this example is the same as the network in Figure 6.5 and Figure 6.6. Notice that the cache contains one entry for each destination network, instead of a separate entry for each destination host. Based on the cache entries, traffic for all hosts (H1, H2, and H3) on network N1 uses the path through R2.

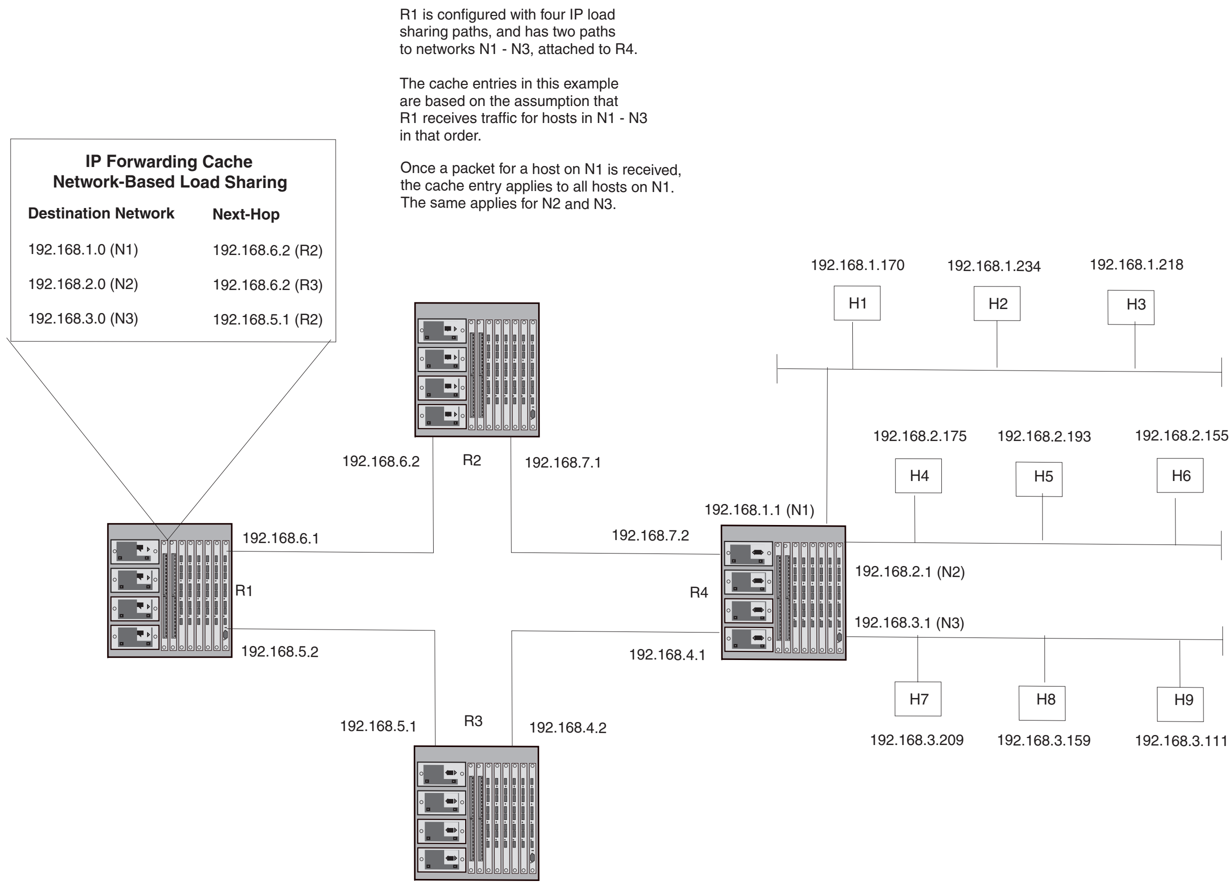


Figure 6.7 Network-based IP load sharing – basic example

Notice that network-based load sharing does not use a simple round-robin method. The path rotation starts with path 2, then proceeds in ascending numerical order through the remaining paths and ends with path 1. In Figure 6.7, the first cache entry uses path 2 instead of path 1. The algorithm evenly distributes the load among the available paths, but starts with the second path instead of the first path.

For optimal results, set the maximum number of paths to a value at least as high as the maximum number of equal-cost paths your network typically contains. For example, if the routing switch you are configuring for IP load sharing has six next-hop routers, set the maximum paths value to six. See “Changing the Maximum Number of Load Sharing Paths” on page 6-59.

NOTE: If the setting for the maximum number of paths is lower than the actual number of equal-cost paths, the software does not use all the paths for load sharing.

The network-based IP load sharing mechanism selects a path based on the following calculation, which involves the maximum number of paths allowed on the routing switch and the number of equal-cost paths available to the destination network.

M modulo P + 1 = S

where:

M = A number from 1 to the maximum number of load-sharing paths. This value increases by 1 until it reaches the maximum, then reverts to 1.

P = Number of equal-cost paths to destination network

S = Selected path

For reference, the following table lists the path that the network-based IP load sharing algorithm will select for each combination of maximum number of paths and number of actual paths to the destination network. The software orders the available paths based on when they enter the IP route table. The first path to enter the table is path 1, and so on.

The rows with maximum path value 4 list the path selections that occur using the default maximum number of load sharing paths, which is four.

Table 6.7: Path Selection for Network-Based IP Load Sharing

Number of Paths	Maximum Paths	Path Counter Value							
		1	2	3	4	5	6	7	8
2	2	2	1						
	3	2	1	2					
	4	2	1	2	1				
	5	2	1	2	1	2			
	6	2	1	2	1	2	1		
	7	2	1	2	1	2	1	2	
	8	2	1	2	1	2	1	2	1
3	2	2	3						
	3	2	3	1					
	4	2	3	1	2				
	5	2	3	1	2	3			
	6	2	3	1	2	3	1		
	7	2	3	1	2	3	1	2	
	8	2	3	1	2	3	1	2	3
4	2	2	3						
	3	2	3	4					
	4	2	3	4	1				
	5	2	3	4	1	2			
	6	2	3	4	1	2	3		
	7	2	3	4	1	2	3	4	
	8	2	3	4	1	2	3	4	1

Table 6.7: Path Selection for Network-Based IP Load Sharing (Continued)

Number of Paths	Maximum Paths	Path Counter Value							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
5	2	2	3						
	3	2	3	4					
	4	2	3	4	5				
	5	2	3	4	5	1			
	6	2	3	4	5	1	2		
	7	2	3	4	5	1	2	3	
	8	2	3	4	5	1	2	3	4
6	2	2	3						
	3	2	3	4					
	4	2	3	4	5				
	5	2	3	4	5	6			
	6	2	3	4	5	6	1		
	7	2	3	4	5	6	1	2	
	8	2	3	4	5	6	1	2	3
7	2	2	3						
	3	2	3	4					
	4	2	3	4	5				
	5	2	3	4	5	6			
	6	2	3	4	5	6	7		
	7	2	3	4	5	6	7	1	
	8	2	3	4	5	6	7	1	2
8	2	2	3						
	3	2	3	4					
	4	2	3	4	5				
	5	2	3	4	5	6			
	6	2	3	4	5	6	7		
	7	2	3	4	5	6	7	8	
	8	2	3	4	5	6	7	8	1

As shown in Table 6.7, the results of the network-based IP load sharing algorithm provide evenly-distributed load sharing. Figure 6.8 shows a network where a routing switch has eight equal-cost paths to destination networks N1 – N8. The routing switch (R1) has been enabled to support up to eight IP load sharing paths.

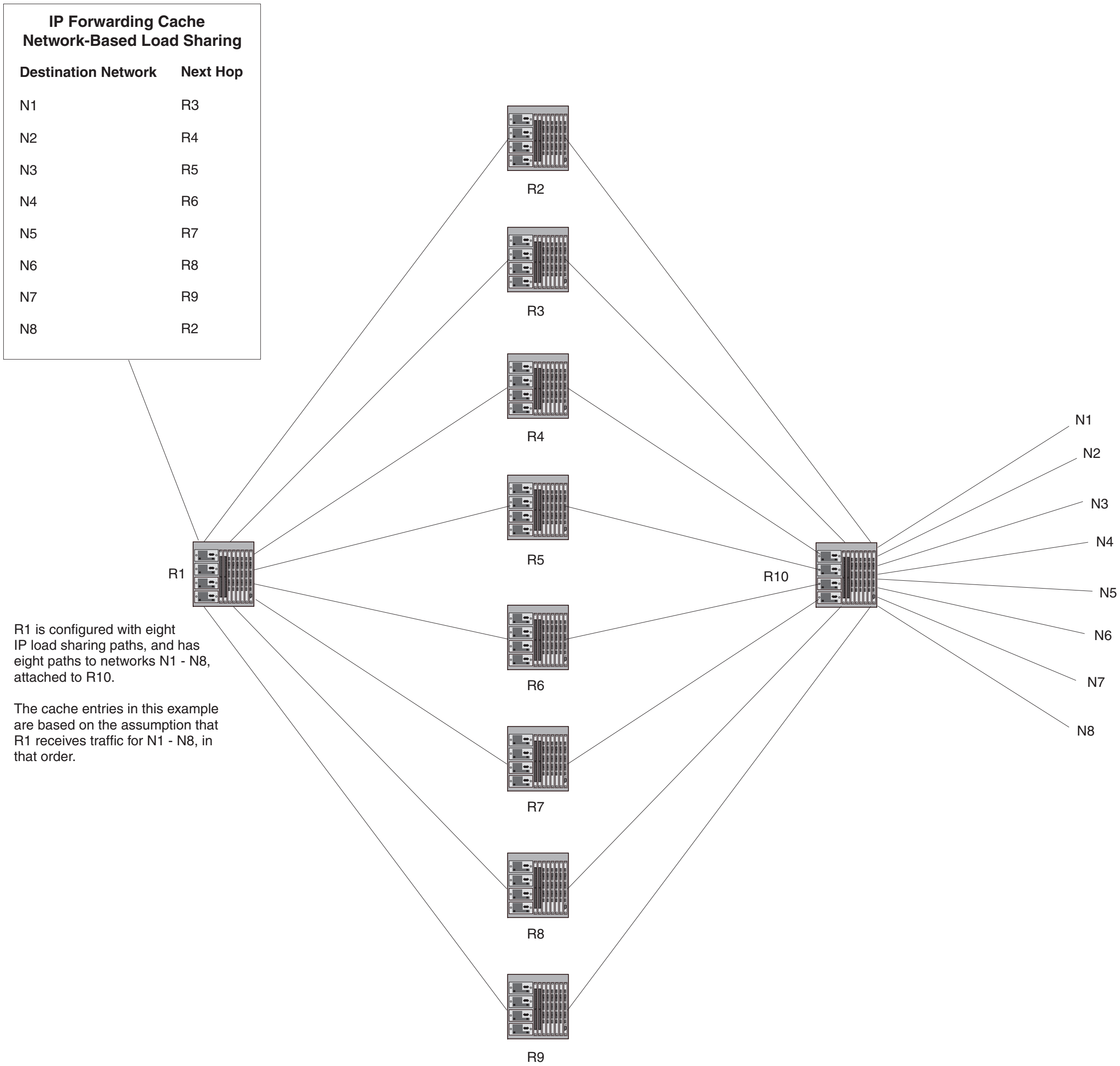


Figure 6.8 Network-based IP load sharing – example with eight equal-cost paths and eight destination networks

As shown in this example, the algorithm for network-based IP load-sharing does not select the paths beginning with the first path, but the algorithm nonetheless results in an evenly distributed selection of paths.

Disabling or Re-Enabling Load Sharing

If you do not use IP load sharing and you want to disable the feature, use either of the following methods.

USING THE CLI

To disable IP load sharing, enter the following commands:

```
HP9300(config)# no ip load-sharing
```

Syntax: [no] ip load-sharing

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Click the Disable radio button next to Load Sharing.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Changing the Load Sharing Method on Chassis routing switches

Chassis routing switches can perform IP load sharing based on destination host address or destination network address. The default for all chassis routing switches is network-based IP load sharing. If you want to enable a chassis routing switch to perform host-based IP load sharing instead, use either of the following methods.

NOTE: The HP 6308M-SX routing switch supports host-based IP load sharing only.

NOTE: Regardless of the method of load sharing that is enabled on a chassis routing switch, the routing switch always load shares paths for default routes and the network default route based on destination host address.

USING THE CLI

To enable host-based IP load sharing, enter the following command:

```
HP9300(config)# ip load-sharing by-host
```

This command enables host-based IP load sharing on the device. The command also disables network-based IP load-sharing at the same time.

Syntax: [no] ip load-sharing by-host

To disable host-based IP load sharing and re-enable network-based IP load sharing, enter the following command:

```
HP9300(config)# no ip load-sharing by-host
```

USING THE WEB MANAGEMENT INTERFACE

You cannot configure this option using the Web management interface.

Enabling Host-Based Load-Sharing for a Specific Destination Network

Chassis routing switches can perform IP load sharing on a network basis or an individual host basis. The default on these devices is network-based load sharing. You can take advantage of the forwarding-cache optimization provided by network-based load sharing while using the more granular host-based load sharing for specific destination networks.

Use this feature when you want to use network-based load sharing by default but also want to use host-based load sharing for specific destination networks.

NOTE: This feature applies only to chassis routing switches. The HP 6308M-SX routing switch performs host-based load sharing for all destinations and cannot be configured for network-based load sharing. Use this feature only when network-based load sharing is enabled.

When you configure host-based load sharing for a specific destination network, the routing switch distributes traffic to hosts on the network evenly across the available paths. For other networks, the routing switch uses a single path for all traffic to hosts on a given network.

NOTE: The host-based load sharing for the destination takes effect only if the IP route table contains an entry that exactly matches the destination network you specify. For example, if you configure host-based load sharing for destination network 207.95.7.0/24, the IP route table must contain a route entry for that network. In fact, for load sharing to occur, the IP route table needs to contain multiple equal-cost paths to the network.

To enable host-based load sharing for a specific destination network, use the following CLI method.

USING THE CLI

To enable host-based load sharing for a specific destination network, enter a command such as the following at the global CONFIG level of the CLI:

```
HP9300(config)# ip load-sharing route-by-host 207.95.7.0/24
```

This command configures the routing switch to use host-based load sharing for traffic to destinations on the 207.95.7.0/24 network. The routing switch uses network-based load sharing for traffic to other destination networks.

Syntax: [no] ip load-sharing route-by-host <ip-addr> <ip-mask>

or

Syntax: [no] ip load-sharing route-by-host <ip-addr>/<mask-bits>

USING THE WEB MANAGEMENT INTERFACE

You cannot configure this option using the Web management interface.

Disabling Host-Based Load-Sharing

You can disable host-based load sharing for specific destination networks or for all networks. When you disable host-based load sharing for a destination network (or for all destination networks), the software removes the host-based forwarding cache entries for the destination network(s) and uses network-based forwarding entries instead.

NOTE: This method applies only to networks for which you have explicitly enabled host-based load sharing. If you have enabled host-based load sharing globally but want to change to network-based load sharing, enter the no ip load-sharing by-host command at the global CONFIG level of the CLI.

Use either of the following methods to disable host-based load sharing for destination networks for which you have configured the feature.

USING THE CLI

To disable host-based load sharing for all the destination networks for which you have explicitly enabled the host-based load sharing, enter the following command at the global CONFIG level of the CLI:

```
HP9300(config)# no ip load-sharing route-by-host
```

To disable host-based load sharing for a specific destination network, enter a command such as the following:

```
HP9300(config)# no ip load-sharing route-by-host 207.95.7.0/24
```

This command removes the host-based load sharing for the 208.95.7.0/24 network, but leaves the other host-based load sharing configurations intact.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure this option using the Web management interface.

Changing the Maximum Number of Load Sharing Paths

By default, IP load sharing allows IP traffic to be balanced across up to four equal paths. You can change the maximum number of paths the routing switch supports to a value from 2 – 8.

For optimal results, set the maximum number of paths to a value at least as high as the maximum number of equal-cost paths your network typically contains. For example, if the routing switch you are configuring for IP load sharing has six next-hop routers, set the maximum paths value to six.

NOTE: If the setting for the maximum number of paths is lower than the actual number of equal-cost paths, the software does not use all the paths for load sharing.

To change the number of paths, use either of the following methods.

USING THE CLI

To change the number of IP load sharing paths, enter a command such as the following:

```
HP9300(config)# ip load-sharing 8
```

Syntax: [no] ip load-sharing [<num>]

The <num> parameter specifies the number of paths and can be from 2 – 8.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Edit the value in the # of Paths field. You can enter a number from 2 – 8.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Optimizing the IP Forwarding Cache

NOTE: This section applies only to routing switches that are running software release 07.1.*X* or higher.

The IP forwarding cache provides fast-path forwarding for IP traffic. The entries in the cache contain the following information:

- Source IP address and TCP or UDP port
- Destination IP address and TCP or UDP port

The default cache settings are adequate for most situations. However, if the routing switch forwards traffic to a very large number of destination hosts or uses default routes to send traffic to a large number of destinations, you may need to adjust the cache settings.

The software on chassis routing switches allows you to adjust the following forwarding cache settings:

- Cache capacity for unicast forwarding entries – The forwarding cache contains a unique entry for each host destination. You can set the cache to allow more unicast forwarding entries by enabling the ***high-performance mode***. This option enables the cache to contain more unique entries for unicast traffic.
- Cache format for default route entries – The forwarding cache contains a unique entry for each host destination of a default route. You can increase the cache's capacity for default route entries by enabling the ***default-route aggregation mode***. This option increases the cache's capacity for default routes by aggregating forwarding information for multiple destinations into single default-route entries.

These optimization options are disabled by default. To enable them, use the following procedures.

Enabling Unicast High-Performance Mode

To increase the capacity of the forwarding cache for unicast entries, use the following CLI method.

NOTE: To place a change to the high-performance mode into effect, you must reload the software after saving the change to the startup-config file.

USING THE CLI

To enable the high-performance mode, enter the following command:

```
HP9300(config)# ip high-perf
HP9300(config)# write memory
HP9300(config)# end
HP9300# reload
```

Syntax: [no] ip high-perf

To disable the high-performance mode, enter the following command:

```
HP9300(config)# no ip high-perf
HP9300(config)# write memory
HP9300(config)# end
HP9300# reload
```

USING THE WEB MANAGEMENT INTERFACE

You cannot configure this option using the Web management interface.

Enabling the Default-Route Aggregation Mode

By default, the IP forwarding cache of a routing switch contains a unique entry for each host destination of a default route. You can increase the cache's capacity for default route entries by enabling the default-route aggregation mode. This option increases the cache's capacity for default routes by aggregating forwarding information for multiple destinations into single default-route entries.

When you enable default route aggregation, the routing switch associates a network prefix length with each forwarding cache entry that is based on a default network route.

The routing switch reprograms the default route cache entries if external events cause a conflict between entries.

To configure the forwarding cache to aggregate entries for default route destinations, use the following CLI method.

NOTE: You do not need to reload the software to place a change to default-route aggregation into effect.

USING THE CLI

To enable the default-route aggregation mode, enter the following command:

```
HP9300(config)# ip dr-aggregate
```

Syntax: [no] ip dr-aggregate

To disable the default-route aggregation mode, enter the following command:

```
HP9300(config)# no ip dr-aggregate
```

USING THE WEB MANAGEMENT INTERFACE

You cannot configure this option using the Web management interface.

Displaying the Forwarding Cache Entries for Default Routes

To display the default route entries in the IP forwarding cache, use the following CLI method. This method enables you to display the default route entries without displaying other types of forwarding entries.

NOTE: To display other types of forwarding cache entries, see "Displaying the Forwarding Cache" on page 6-88.

USING THE CLI

To display the default route cache entries, enter the following command at any level of the CLI:

```
HP9300(config)# show ip dr-aggregate
```

Syntax: show ip dr-aggregate [<ip-addr>]

If you specify an IP address, only the entries for that destination are displayed.

Here is an example of the information displayed by this command.

```
HP9300(config)# show ip dr-aggregate
Total number of cache entries: 2
Start index: 1  D:Dynamic  P:Permanent  F:Forward  U:Us  C:Complex Filter
W:Wait ARP  I:ICMP Deny  K:Drop  R:Fragment  S:Snap Encap
      IP Address         Next Hop        MAC              Type  Port  Vlan  Pri
1     22.22.22.22    /8  207.95.6.60     0044.052e.4302   DF    1/1   1     0
2     207.96.7.7     /12 207.95.6.60     0044.052e.4302   DF    1/1   1     0
```

This example shows two entries. The prefix associated with each entry is displayed. Notice that the prefix lengths in this example are different for each entry. The software selects a prefix length long enough to make the default network route entry unambiguous, so that is does not conflict with other cache entries.

To display the entry for a specific destination, enter the destination address, as shown in the following example.

```
HP9300(config)# show ip dr-aggregate 207.96.7.7
Total number of cache entries: 2
Start index: 1  D:Dynamic  P:Permanent  F:Forward  U:Us  C:Complex Filter
W:Wait ARP  I:ICMP Deny  K:Drop  R:Fragment  S:Snap Encap
      IP Address         Next Hop        MAC              Type  Port  Vlan  Pri
1     207.96.7.7     /12 207.95.6.60     0044.052e.4302   DF    1/1   1     0
```

This example shows the second entry from the previous example, but the entry row number is 1. The row number identifies the row number in the displayed output. In addition, notice that the Total number of cache entries field shows 2, as in the previous example. The number in this field indicates the total number of default route aggregation entries in the forwarding cache.

USING THE WEB MANAGEMENT INTERFACE

You cannot display the default-route cache entries using the Web management interface.

Clearing the Forwarding Cache Entries for Default Routes

You can clear the default route entries from the IP forwarding cache. To do so, use the following CLI method.

NOTE: This command does not affect other types of forwarding cache entries.

USING THE CLI

To clear the default-route cache entries, enter the following command from the Privileged EXEC level of the CLI:

```
HP9300# clear ip dr-aggregate
```

Syntax: clear ip dr-aggregate

USING THE WEB MANAGEMENT INTERFACE

You cannot clear the entries using the Web management interface.

Configuring IRDP

The ICMP Router Discovery Protocol (IRDP) is used by HP routing switches to advertise the IP addresses of its router interfaces to directly attached hosts. IRDP is disabled by default. You can enable the feature on a global basis or on an individual port basis.

- If you enable the feature globally, all ports use the default values for the IRDP parameters.
- If you leave the feature disabled globally but enable it on individual ports, you also can configure the IRDP parameters on an individual port basis.

NOTE: You can configure IRDP parameters only an individual port basis. To do so, IRDP must be disabled globally and enabled only on individual ports. You cannot configure IRDP parameters if the feature is globally enabled.

When IRDP is enabled, the routing switch periodically sends Router Advertisement messages out the IP interfaces on which the feature is enabled. The messages advertise the routing switch's IP addresses to directly attached hosts who listen for the messages. In addition, hosts can be configured to query the routing switch for the information by sending Router Solicitation messages.

Some types of hosts use the Router Solicitation messages to discover their default gateway. When IRDP is enabled on the HP routing switch, the routing switch responds to the Router Solicitation messages. Some clients interpret this response to mean that the routing switch is the default gateway. If another router is actually the default gateway for these clients, leave IRDP disabled on the HP routing switch.

IRDP uses the following parameters. If you enable IRDP on individual ports instead of enabling the feature globally, you can configure these parameters on an individual port basis.

- Packet type – The routing switch can send Router Advertisement messages as IP broadcasts or as IP multicasts addressed to IP multicast group 224.0.0.1. The packet type is IP broadcast.
- Maximum message interval and minimum message interval – When IRDP is enabled, the routing switch sends the Router Advertisement messages every 450 – 600 seconds by default. The time within this interval that the routing switch selects is random for each message and is not affected by traffic loads or other network factors. The random interval minimizes the probability that a host will receive Router Advertisement messages from other routers at the same time. The interval on each IRDP-enabled routing switch interface is independent of the interval on other IRDP-enabled interfaces. The default maximum message interval is 600 seconds. The default minimum message interval is 450 seconds.
- Hold time – Each Router Advertisement message contains a hold time value. This value specifies the maximum amount of time the host should consider an advertisement to be valid until a newer advertisement arrives. When a new advertisement arrives, the hold time is reset. The hold time is always longer than the maximum advertisement interval. Therefore, if the hold time for an advertisement expires, the host can reasonably conclude that the router interface that sent the advertisement is no longer available. The default hold time is three times the maximum message interval.
- Preference – If a host receives multiple Router Advertisement messages from different routers, the host selects the router that sent the message with the highest preference as the default gateway. The preference can be a number from -4294967296 to 4294967295. The default is 0.

Enabling IRDP Globally

To enable IRDP globally, use either of the following methods.

USING THE CLI

To globally enable IRDP, enter the following command:

```
HP9300(config)# ip irdp
```

This command enables IRDP on the IP interfaces on all ports. Each port uses the default values for the IRDP parameters. The parameters are not configurable when IRDP is globally enabled.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the list of configuration options.
3. Click on the plus sign next to IP to display the list of IP configuration options.
4. Select the General link to display the IP configuration panel.
5. Select Enable next to IRDP.
6. Click the Apply button to save the change to the device's running-config.

7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Enabling IRDP on an Individual Port

To enable IRDP on an individual port and configure IRDP parameters, use either of the following methods.

USING THE CLI

To enable IRDP on an individual interface and change IRDP parameters, enter commands such as the following:

```
HP9300(config)# interface ethernet 1/3
HP9300(config-if-1/3)# ip irdp maxadvertinterval 400
```

This example shows how to enable IRDP on a specific port and change the maximum advertisement interval for Router Advertisement messages to 400 seconds.

NOTE: To enable IRDP on individual ports, you must leave the feature globally disabled.

Syntax: [no] ip irdp [broadcast | multicast] [holdtime <seconds>] [maxadvertinterval <seconds>] [minadvertinterval <seconds>] [preference <number>]

The **broadcast | multicast** parameter specifies the packet type the routing switch uses to send Router Advertisement.

- **broadcast** – The routing switch sends Router Advertisement as IP broadcasts. This is the default.
- **multicast** – The routing switch sends Router Advertisement as multicast packets addressed to IP multicast group 224.0.0.1.

The **holdtime** <seconds> parameter specifies how long a host that receives a Router Advertisement from the routing switch should consider the advertisement to be valid. When a host receives a new Router Advertisement message from the routing switch, the host resets the hold time for the routing switch to the hold time specified in the new advertisement. If the hold time of an advertisement expires, the host discards the advertisement, concluding that the router interface that sent the advertisement is no longer available. The value must be greater than the value of the **maxadvertinterval** parameter and cannot be greater than 9000. The default is three times the value of the **maxadvertinterval** parameter.

The **maxadvertinterval** parameter specifies the maximum amount of time the routing switch waits between sending Router Advertisements. You can specify a value from 1 to the current value of the **holdtime** parameter. The default is 600 seconds.

The **minadvertinterval** parameter specifies the minimum amount of time the routing switch can wait between sending Router Advertisements. The default is three-fourths (0.75) the value of the **maxadvertinterval** parameter. If you change the **maxadvertinterval** parameter, the software automatically adjusts the **minadvertinterval** parameter to be three-fourths the new value of the **maxadvertinterval** parameter. If you want to override the automatically configured value, you can specify an interval from 1 to the current value of the **maxadvertinterval** parameter.

The **preference** <number> parameter specifies the IRDP preference level of this routing switch. If a host receives Router Advertisements from multiple routers, the host selects the router interface that sent the message with the highest interval as the host's default gateway. The valid range is -4294967296 to 4294967295. The default is 0.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure these options using the Web management interface.

Configuring RARP

The Reverse Address Resolution Protocol (RARP) provides a simple mechanism for directly-attached IP hosts to boot over the network. RARP allows an IP host that does not have a means of storing its IP address across power cycles or software reloads to query a directly-attached router for an IP address.

RARP is enabled by default. However, you must create a RARP entry for each host that will use the routing switch for booting. A RARP entry consists of the following information:

- The entry number – the entry's sequence number in the RARP table.
- The MAC address of the boot client.
- The IP address you want the routing switch to give to the client.

When a client sends a RARP broadcast requesting an IP address, the routing switch responds to the request by looking in the RARP table for an entry that contains the client's MAC address:

- If the RARP table contains an entry for the client, the routing switch sends a unicast response to the client that contains the IP address associated with the client's MAC address in the RARP table.
- If the RARP table does not contain an entry for the client, the routing switch silently discards the RARP request and does not reply to the client.

How RARP Differs from BootP/DHCP

RARP and BootP/DHCP are different methods for providing IP addresses to IP hosts when they boot. These methods differ in the following ways:

- Location of configured host addresses
    - RARP requires static configuration of the host IP addresses on the routing switch. The routing switch replies directly to a host's request by sending an IP address you have configured in the RARP table.
    - The routing switch forwards BootP and DHCP requests to a third-party BootP/DHCP server that contains the IP addresses and other host configuration information.
- Connection of host to boot source (routing switch or BootP/DHCP server):
    - RARP requires the IP host to be directly attached to the routing switch.
    - An IP host and the BootP/DHCP server can be on different networks and on different routers, so long as the routers are configured to forward ("help") the host's boot request to the boot server.
    - You can centrally configure other host parameters on the BootP/DHCP server, in addition to the IP address, and supply those parameters to the host along with its IP address.

To configure the routing switch to forward BootP/DHCP requests when boot clients and the boot servers are on different sub-nets on different routing switch interfaces, see "Configuring BootP/DHCP Forwarding Parameters" on page 6-70.

Disabling RARP

RARP is enabled by default. If you want to disable the feature, you can do so using either of the following methods.

USING THE CLI

To disable RARP, enter the following command at the global CONFIG level:

```
HP9300(config)# no ip rarp
```

Syntax: [no] ip rarp

To re-enable RARP, enter the following command:

```
HP9300(config)# ip rarp
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Select the Disable or Enable radio button next to RARP.

6. Click the Apply button to save the change to the device’s running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Creating Static RARP Entries

You must configure the RARP entries for the RARP table. The routing switch can send an IP address in reply to a client’s RARP request only if create a RARP entry for that client.

To configure static RARP entries, use the following methods.

USING THE CLI

To assign a static IP RARP entry for static routes on an HP routing switch, enter a command such as the following:

```
HP9300(config)# rarp 1 1245.7654.2348 192.53.4.2
```

This command creates a RARP entry for a client with MAC address 1245.7654.2348. When the routing switch receives a RARP request from this client, the routing switch replies to the request by sending IP address 192.53.4.2 to the client.

Syntax: rarp <number> <mac-addr>.<ip-addr>

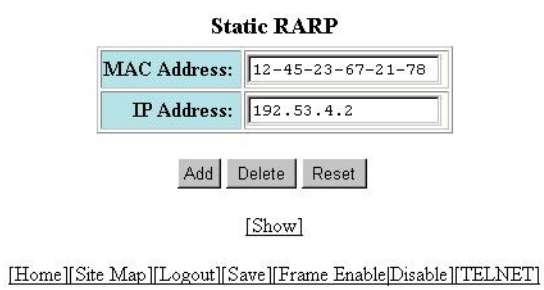
The <number> parameter identifies the RARP entry number. You can specify an unused number from 1 to the maximum number of RARP entries supported on the device. To determine the maximum number of entries supported on the device, see the “Configuring Basic Features” chapter of the *Installation and Getting Started Guide*.

The <mac-addr> parameter specifies the MAC address of the RARP client.

The <ip-addr> parameter specifies the IP address the routing switch will give the client in response to the client’s RARP request.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Click the Static RARP link.
   - If the device does not have any static RARP entries, the Static RARP configuration panel is displayed, as shown in the following example.
   - If a static RARP entry is already configured and you are adding a new entry, click on the Add Static RARP link to display the Static RARP configuration panel, as shown in the following example.
   - If you are modifying an existing static RARP entry, click on the Modify button to the right of the row describing the entry to display the Static RARP configuration panel, as shown in the following example.



6. Enter the MAC address.

7. Enter the IP address.
8. Click the Add button to save the change to the device's running-config file.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Changing the Maximum Number of Static RARP Entries Supported

The number of RARP entries the routing switch supports depends on how much memory the routing switch has. To determine how many RARP entries your routing switch can have, display the system default information using the procedure in the "Configuring Basic Features" chapter of the *Installation and Getting Started Guide*.

If your routing switch allows you to increase the maximum number of RARP entries, you can use a procedure in the same section to do so.

NOTE: You must save the configuration to the startup-config file and reload the software after changing the RARP cache size to place the change into effect.

Configuring UDP Broadcast and IP Helper Parameters

Some applications rely on client requests sent as limited IP broadcasts addressed to the UDP's application port. If a server for the application receives such a broadcast, the server can reply to the client. Routers do not forward limited broadcasts, so the client and server must be on the same network for the broadcast to reach the server. If the client and server are on different networks (on opposite sides of a router), the client's request cannot reach the server.

You can configure the routing switch to forward clients' requests to UDP application servers. To do so:

- Enable forwarding support for the UDP application port, if forwarding support is not already enabled.
- Configure a helper adders on the interface connected to the clients. Specify the helper address to be the IP address of the application server or the limited broadcast address for the IP sub-net the server is in. A helper address is associated with a specific interface and applies only to client requests received on that interface. The routing switch forwards client requests for any of the application ports the routing switch is enabled to forward to the helper address.

Forwarding support for the following application ports is enabled by default.

- bootps (port 67)
- dns (port 53)
- tftp (port 69)
- time (port 37)
- netbios-ns (port 137)
- netbios-dgm (port 138)
- tacacs (port 65)

NOTE: The application names are the names for these applications that the routing switch software recognizes, and might not match the names for these applications on some third-party devices. The numbers listed in parentheses are the UDP port numbers for the applications. The numbers come from RFC 1340.

NOTE: As shown above, forwarding support for BootP/DHCP is enabled by default. If you are configuring the routing switch to forward BootP/DHCP requests, see "Configuring BootP/DHCP Forwarding Parameters" on page 6-70.

You can enable forwarding for other applications by specifying the application port number.

You also can disable forwarding for an application.

NOTE: If you disable forwarding for a UDP application, forwarding of client requests received as broadcasts to helper addresses is disabled. Disabling forwarding of an application does not disable other support for the application. For example, if you disable forwarding of Telnet requests to helper addresses, other Telnet support on the routing switch is not also disabled.

Enabling Forwarding for a UDP Application

If you want the routing switch to forward client requests for UDP applications that the routing switch does not forward by default, you can enable forwarding support for the port. To enable forwarding support for a UDP application, use either of the following methods. You also can disable forwarding for an application using these methods.

NOTE: You also must configure a helper address on the interface that is connected to the clients for the application. The routing switch cannot forward the requests unless you configure the helper address. See "Configuring an IP Helper Address" on page 6-71.

USING THE CLI

To enable the forwarding of SNMP trap broadcasts, enter the following command:

```
HP9300(config)# ip forward-protocol udp snmp-trap
```

Syntax: [no] ip forward-protocol udp <udp-port-name> | <udp-port-num>

The <udp-port-name> parameter can have one of the following values. For reference, the corresponding port numbers from RFC 1340 are shown in parentheses. If you specify an application name, enter the name only, not the parentheses or the port number shown here.

- bootpc (port 68)
- bootps (port 67)
- discard (port 9)
- dns (port 53)
- dnsix (port 90)
- echo (port 7)
- mobile-ip (port 434)
- netbios-dgm (port 138)
- netbios-ns (port 137)
- ntp (port 123)
- tacacs (port 65)
- talk (port 517)
- time (port 37)
- tftp (port 69)

In addition, you can specify any UDP application by using the application's UDP port number.

The <udp-port-num> parameter specifies the UDP application port number. If the application you want to enable is not listed above, enter the application port number. You also can list the port number for any of the applications listed above.

To disable forwarding for an application, enter a command such as the following:

```
HP9300(config)# no ip forward-protocol udp snmp
```

This command disables forwarding of SNMP requests to the helper addresses configured on routing switch interfaces.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Select the Disable or Enable radio button next to Broadcast Forward.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

NOTE: To define the ports to be forwarded, select the UDP Helper link from the IP configuration sheet.

Configuring an IP Helper Address

To forward a client's broadcast request for a UDP application when the client and server are on different networks, you must configure a helper address on the interface connected to the client. Specify the server's IP address or the limited broadcast address of the IP sub-net the server is in as the helper address.

You can configure up to four helper addresses on each interface. You can configure a helper address on an Ethernet port or a virtual interface. To configure a helper address, use either of the following methods.

USING THE CLI

To configure a helper address on interface 2 on chassis module 1, enter the following commands:

```
HP9300(config)# interface e 1/2
HP9300(config-if-1/2)# ip helper-address 1 207.95.7.6
```

The commands in this example change the CLI to the configuration level for port 1/2, then add a helper address for server 207.95.7.6 to the port. If the port receives a client request for any of the applications that the routing switch is enabled to forward, the routing switch forwards the client's request to the server.

Syntax: ip helper-address <num> <ip-addr>

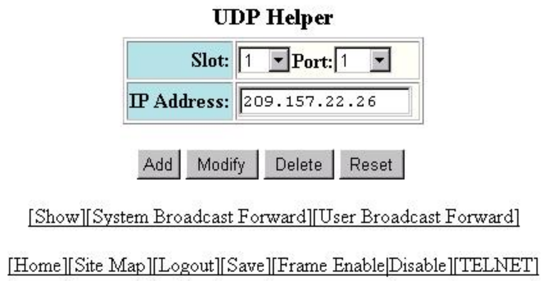
The <num> parameter specifies the helper address number and can be from 1 – 4. Thus, an interface can have up to four helper addresses.

The <ip-addr> command specifies the server's IP address or the limited broadcast address of the IP sub-net the server is in.

USING THE WEB MANAGEMENT INTERFACE

To configure a helper address on an interface:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Click on the UDP Helper link.
   - If the device does not have any UDP helper assignments, the UDP Helper configuration panel is displayed, as shown in the following example.
   - If a UDP helper assignment is already configured and you are adding a new one, click on the Add UDP Helper link to display the UDP Helper configuration panel, as shown in the following example.
   - If you are modifying an existing UDP helper assignment, click on the Modify button to the right of the row describing the assignment to display the UDP Helper configuration panel, as shown in the following example.



5. Select the port (and slot if applicable) on behalf of which the UDP helper packets will be forwarded.
6. Enter the IP address of the remote server for which the routing switch will be relaying the packets.
7. Click the Add button to save the change to the device's running-config file.
8. To configure settings for another port, select the port (and slot, if applicable) and go to step 6.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

To select an application to be forwarded to the server by the routing switch:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Click on the UDP Helper link.
5. Click on the Modify button to the right of the row describing the UDP helper assignment to display the UDP Helper configuration panel.
6. Click on the System Broadcast Forward or User Broadcast Forward link.
   - The System Broadcast Forward link displays a panel that lets you select a well-known UDP port.
   - The User Broadcast Forward link displays a panel that lets you enter any port number.
7. Select the port or enter a port number from 1 – 65535.
8. Click the Add button to save the change to the device's running-config file.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring BootP/DHCP Forwarding Parameters

A host on an IP network can use BootP/DHCP to obtain its IP address from a BootP/DHCP server. To obtain the address, the client sends a BootP/DHCP request. The request is a limited broadcast and is addressed to UDP port 67. A limited IP broadcast is addressed to IP address 255.255.255.255 and is not forwarded by the HP routing switch or other IP routers.

When the BootP/DHCP client and server are on the same network, the server receives the broadcast request and replies to the client. However, when the client and server are on different networks, the server does not receive the client's request, because the routing switch does not forward the request.

You can configure the routing switch to forward BootP/DHCP requests. To do so, configure a helper address on the interface that receives the client requests, and specify the BootP/DHCP server's IP address as the address you are helping the BootP/DHCP requests to reach. Instead of the server's IP address, you can specify the limited broadcast address of the IP sub-net the server is in.

BootP/DHCP Forwarding Parameters

The following parameters control the routing switch's forwarding of BootP/DHCP requests:

- Helper address – The BootP/DHCP server's IP address. You must configure the helper address on the interface that receives the BootP/DHCP requests from the client. The routing switch cannot forward a request to the server unless you configure a helper address for the server.
- Gateway address – The routing switch places the IP address of the interface that received the BootP/DHCP request in the request packet's Gateway Address field (sometimes called the Router ID field). When the server responds to the request, the server sends the response as a unicast packet to the IP address in the Gateway Address field. (If the client and server are directly attached, the Gateway ID field is empty and the server replies to the client using a unicast or broadcast packet, depending on the server.)

  By default, the routing switch uses the lowest-numbered IP address on the interface that receives the request as the Gateway address. You can override the default by specifying the IP address you want the routing switch to use.
- Hop Count – Each router that forwards a BootP/DHCP packet increments the hop count by 1. Routers also discard a forwarded BootP/DHCP request instead of forwarding the request if the hop count is greater than the maximum number of BootP/DHCP hops allows by the router. By default, an HP ProCurve routing switch forwards a BootP/DHCP request if its hop count is four or less, but discards the request if the hop count is greater than four. You can change the maximum number of hops the routing switch will allow to a value from 1 – 15.

NOTE: The BootP/DHCP hop count is not the TTL parameter.

Configuring an IP Helper Address

The procedure for configuring a helper address for BootP/DHCP requests is the same as the procedure for configuring a helper address for other types of UDP broadcasts. See "Configuring an IP Helper Address" on page 6-69.

Changing the IP Address Used for Stamping BootP/DHCP Requests

When the routing switch forwards a BootP/DHCP request, the routing switch "stamps" the Gateway Address field. The default value the routing switch uses to stamp the packet is the lowest-numbered IP address configured on the interface that received the request. If you want the routing switch to use a different IP address to stamp requests received on the interface, use either of the following methods to specify the address.

The BootP/DHCP stamp address is an interface parameter. Change the parameter on the interface that is connected to the BootP/DHCP client.

USING THE CLI

To change the IP address used for stamping BootP/DHCP requests received on interface 1/1, enter commands such as the following:

```
HP9300(config)# int e 1/1
HP9300(config-if-1/1)# ip bootp-gateway 109.157.22.26
```

These commands change the CLI to the configuration level for port 1/1, then change the BootP/DHCP stamp address for requests received on port 1/1 to 192.157.22.26. The routing switch will place this IP address in the Gateway Address field of BootP/DHCP requests that the routing switch receives on port 1/1 and forwards to the BootP/DHCP server.

Syntax: ip bootp-gateway <ip-addr>

USING THE WEB MANAGEMENT INTERFACE

You cannot change the IP address used for stamping BootP/DHCP requests using the Web management interface.

Changing the Maximum Number of Hops to a BootP Relay Server

Each BootP/DHCP request includes a field Hop Count field. The Hop Count field indicates how many routers the request has passed through. When the routing switch receives a BootP/DHCP request, the routing switch looks at the value in the Hop Count field.

- If the hop count value is equal to or less than the maximum hop count the routing switch allows, the routing switch increments the hop count by one and forwards the request.
- If the hop count is greater than the maximum hop count the routing switch allows, the routing switch discards the request.

To change the maximum number of hops the routing switch allows for forwarded BootP/DHCP requests, use either of the following methods.

NOTE: The BootP/DHCP hop count is not the TTL parameter.

USING THE CLI

To modify the maximum number of BootP/DHCP hops, enter the following command:

```
HP9300(config)# bootp-relay-max-hops 10
```

This command allows the routing switch to forward BootP/DHCP requests that have passed through up to ten previous hops before reaching the routing switch.

Syntax: bootp-relay-max-hops <1-15>

USING THE WEB MANAGEMENT INTERFACE

To modify the maximum number of hops supported:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the list of configuration options.
3. Click on the plus sign next to IP to display the list of IP configuration options.
4. Select the General link to display the IP configuration panel.
5. Enter a value from 1 – 15 in the BootP Relay Maximum Hop field.
6. Click the Apply button to save the change to the device’s running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Configuring IP Parameters – HP 6208M-SX

The following sections describe how to configure IP parameters on the HP 6208M-SX.

NOTE: This section describes how to configure IP parameters for the HP 6208M-SX switch. For IP configuration information for routing switches, see “Configuring IP Parameters – Routing Switches” on page 6-18.

Configuring the Management IP Address and Specifying the Default Gateway

To manage the switch using Telnet or Secure Shell (SSH) CLI connections or the Web management interface, you must configure an IP address for the switch. Optionally, you also can specify the default gateway.

HP ProCurve devices support both classical IP network masks (Class A, B, and C sub-net masks, and so on) and Classless Interdomain Routing (CIDR) network prefix masks.

- To enter a classical network mask, enter the mask in IP address format. For example, enter “209.157.22.99 255.255.255.0” for an IP address with a Class-C sub-net mask.
- To enter a prefix network mask, enter a forward slash (/) and the number of bits in the mask immediately after the IP address. For example, enter “209.157.22.99/24” for an IP address that has a network mask with 24 significant bits (ones).

By default, the CLI displays network masks in classical IP address format (example: 255.255.255.0). You can change the display to prefix format. See “Changing the Network Mask Display to Prefix Format” on page 6-80.

To configure an IP address and specify the default gateway, use the following CLI method.

USING THE CLI

To assign an IP address to the HP 6208M-SX, enter a command such as the following at the global CONFIG level:

```
HP6208(config)# ip address 192.45.6.110 255.255.255.0
```

Syntax: ip address <ip-addr> <ip-mask>

or

Syntax: ip address <ip-addr>/<mask-bits>

NOTE: You also can enter the IP address and mask in CIDR format, as follows:

```
HP6208(config)# ip address 192.45.6.1/24
```

To specify the switch’s default gateway, enter a command such as the following:

```
HP6208(config)# ip default-gateway 192.45.6.1 255.255.255.0
```

Syntax: ip default-gateway <ip-addr>

or

Syntax: ip default-gateway <ip-addr>/<mask-bits>

USING THE WEB MANAGEMENT INTERFACE

You cannot perform initial configuration of the management IP address using the Web management interface, but you can change an address you already configured. You also can configure the default gateway. Use the following procedure.

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the list of configuration options.
3. Click on the plus sign next to IP to display the list of IP configuration options.
4. Select the IP Address link to display the IP address configuration panel.

5. Enter the IP address in the IP address field.
6. Enter the sub-net mask in the Subnet Mask field.
7. Enter the default gateway's IP address in the Default Gateway field.
8. Click the Apply button to save the change to the device's running-config file.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring Domain Name Server (DNS) Resolver

The Domain Name Server (DNS) resolver feature lets you use a host name to perform Telnet, ping, and traceroute commands. You can also define a DNS domain on the device and thereby recognize all hosts within that domain. After you define a domain name, the device automatically appends the appropriate domain to the host and forwards it to the domain name server.

For example, if the domain "newyork.com" is defined on a device and you want to initiate a ping to host "NYC01" on that domain, you need to reference only the host name in the command instead of the host name and its domain name. For example, you could enter either of the following commands to initiate the ping:

```
HP6208# ping nyc01
HP6208# ping nyc01.newyork.com
```

Defining a DNS Entry

You can define up to four DNS servers for each DNS entry. The first entry serves as the primary default address. If a query to the primary address fails to be resolved after three attempts, the next gateway address is queried (also up to three times). This process continues for each defined gateway address until the query is resolved. The order in which the default gateway addresses are polled is the same as the order in which you enter them.

USING THE CLI

Suppose you want to define the domain name of newyork.com on the HP 6208M-SX and then define four possible default DNS gateway addresses. To do so, enter the following commands:

```
HP6208(config)# ip dns domain-name newyork.com
HP6208(config)# ip dns server-address 209.157.22.199 205.96.7.15 208.95.7.25
201.98.7.15
```

Syntax: ip dns server-address <ip-addr> [<ip-addr>] [<ip-addr>] [<ip-addr>]

In this example, the first IP address in the **ip dns server-address...** command becomes the primary gateway address and all others are secondary addresses. Because IP address 201.98.7.15 is the last address listed, it is also the last address consulted to resolve a query.

USING THE WEB MANAGEMENT INTERFACE

To map a domain name server to multiple IP addresses:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Do one of the following:
    - On the HP 6208M-SX – Select the DNS link to display the DNS panel.
    - On a routing switch – Click on the plus sign next to Configure in the tree view, then click on the plus sign next to IP, then select DNS to display the DNS panel.
3. Enter the domain name in the Domain Name field.
4. Enter an IP address for each device that will serve as a gateway to the domain name server.

NOTE: The first address entered will be the primary DNS gateway address. The other addresses will be used in chronological order, left to right, if the primary address is available.

5. Click the Apply button to save the change to the device's running-config file.
6. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Using a DNS Name To Initiate a Trace Route

EXAMPLE:

Suppose you want to trace the route from the HP 6208M-SX to a remote server identified as NYC02 on domain newyork.com. Because the newyork.com domain is already defined on the switch, you need to enter only the host name, NYC02, as noted below.

USING THE CLI

```
HP6208# traceroute nyc02
```

Syntax: traceroute <host-ip-addr> [maxttl <value>] [minttl <value>] [numeric] [timeout <value>] [source-ip <ip addr>]

The only required parameter is the IP address of the host at the other end of the route. See the *Command Line Interface Reference* for information about the parameters.

After you enter the command, a message indicating that the DNS query is in process and the current gateway address (IP address of the domain name server) being queried appear on the screen:

```
Type Control-c to abort
Sending DNS Query to 209.157.22.199
Tracing Route to IP node 209.157.22.80
To ABORT Trace Route, Please use stop-traceroute command.
 Trac ed route to target IP node 209.157.22.80:
  IP   Address         Round Trip Time 1    Round Trip Time2
 207 .95.6.30         93 msec           121 msec
```

NOTE: In the above example, 209.157.22.199 is the IP address of the domain name server (default DNS gateway address), and 209.157.22.80 represents the IP address of the NYC02 host.

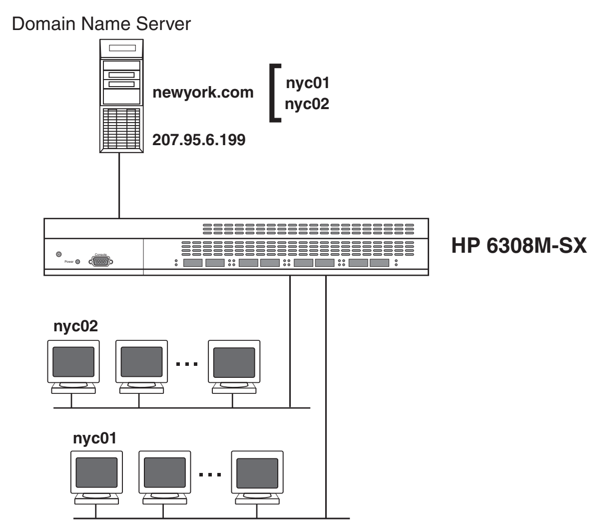


Figure 6.9 Querying a host on the newyork.com domain

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.

2. Click on the plus sign next to Command in the tree view to list the command options.
3. Select the Trace Route link to display the Trace Route panel.
4. Enter the host name or IP address in the Target Address field.

NOTE: You can use the host name only if you have already configured the DNS resolver for the domain that contains the host.

5. Optionally change the minimum and maximum TTLs and the Timeout.
6. Click on Start to begin the trace. The trace results are displayed below the Start and Abort buttons.

Changing the TTL Threshold

The TTL threshold prevents routing loops by specifying the maximum number of router hops an IP packet originated by the switch can travel through. Each device capable of forwarding IP that receives the packet decrements (decreases) the packet's TTL by one. If a routing switch receives a packet with a TTL of 1 and reduces the TTL to zero, the routing switch drops the packet.

The default TTL is 64. You can change the TTL to a value from 1 – 255.

To modify the TTL, use the following CLI method.

USING THE CLI

To modify the TTL threshold to 25, enter the following commands:

```
HP6208(config)# ip ttl 25
HP6208(config)# exit
```

Syntax: ip ttl <1-255>

USING THE WEB MANAGEMENT INTERFACE

You cannot change the TTL on the HP 6208M-SX using the Web management interface.

Configuring DHCP Assist

DHCP Assist allows the HP 6208M-SX to assist a routing switch that is performing multi-netting on its interfaces as part of its DHCP relay function.

DHCP Assist ensures that a DHCP server that manages multiple IP sub-nets can readily recognize the requester's IP sub-net, even when that server is not on the client's local LAN segment. The switch does so by stamping each request with its IP gateway address in the DHCP discovery packet.

NOTE: HP ProCurve routing switches provide BootP/DHCP assistance by default on an individual port basis. See "Changing the IP Address Used for Stamping BootP/DHCP Requests" on page 6-71.

By allowing multiple sub-net DHCP requests to be sent on the same wire, you can reduce the number of router ports required to support secondary addressing as well as reduce the number of DHCP servers required, by allowing a server to manage multiple sub-net address assignments.

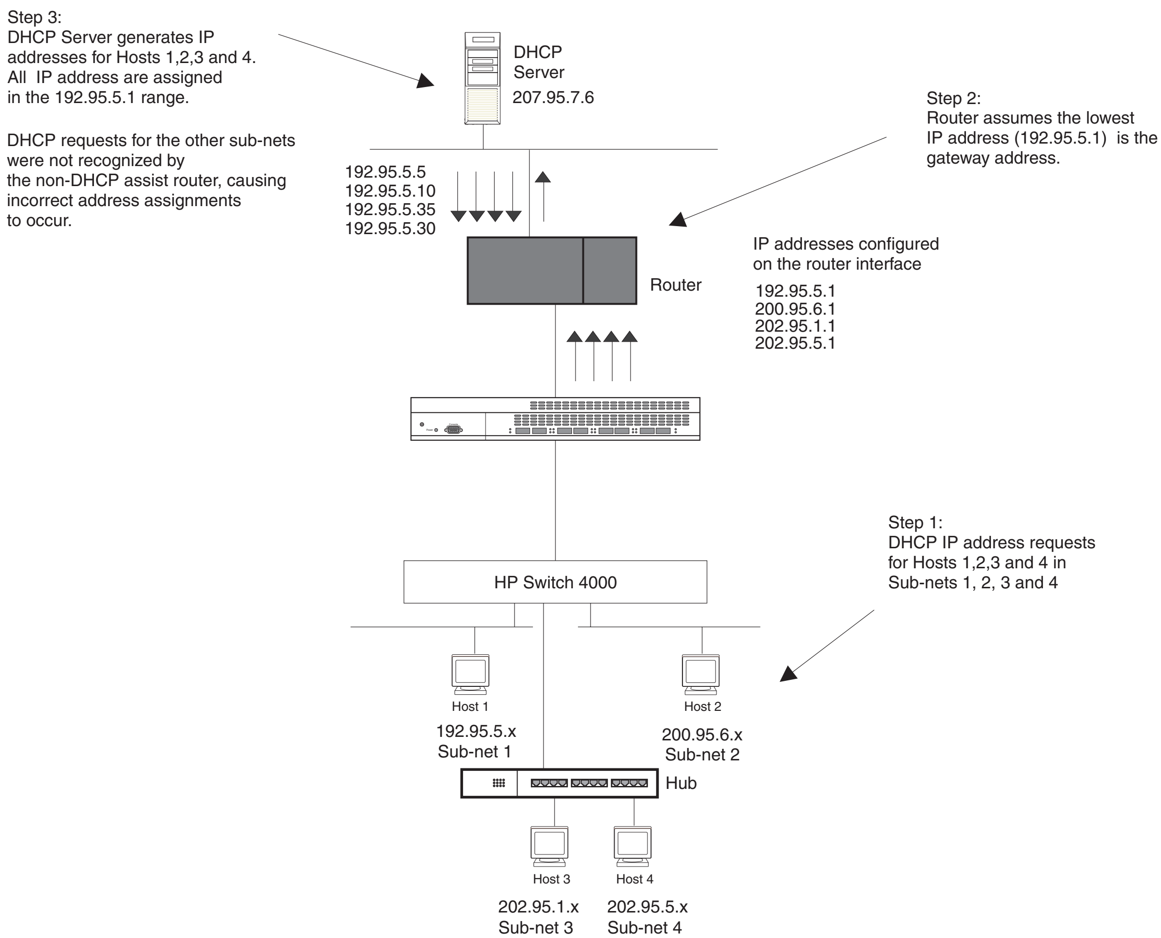


Figure 6.10 DHCP requests in a network without DHCP Assist on the switch

In a network operating without DHCP Assist, hosts can be assigned IP addresses from the wrong sub-net range because a routing switch with multiple sub-nets configured on an interface cannot distinguish among DHCP discovery packets received from different sub-nets.

For example, in Figure 6.10 a host from each of the four sub-nets supported on a switch requests an IP address from the DHCP server. These requests are sent transparently to the router. Because the router is unable to determine the origin of each packet by sub-net, it assumes the lowest IP address or the ‘primary address’ is the gateway for all ports on the switch and stamps the request with that address.

When the DHCP request is received at the server, it assigns all IP addresses within that range only.

With DHCP Assist enabled on the HP 6208M-SX, correct assignments are made because the switch provides the stamping service.

How DHCP Assist Works

Upon initiation of a DHCP session, the client sends out a DHCP discovery packet for an address from the DHCP server as seen in Figure 6.11. When the DHCP discovery packet is received at an HP 6208M-SX with the DHCP Assist feature enabled, the gateway address configured on the receiving interface is inserted into the packet. This address insertion is also referred to as stamping.

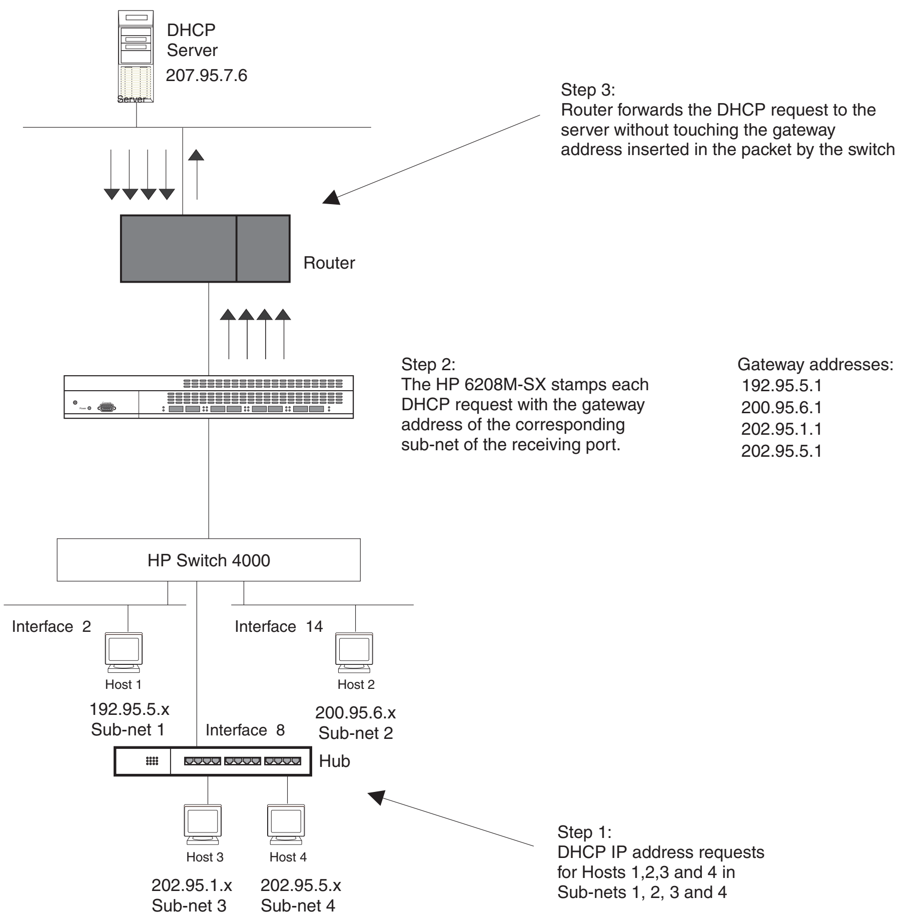


Figure 6.11 DHCP requests in a network with DHCP Assist operating on the HP 6208M-SX

When the stamped DHCP discovery packet is then received at the router, it is forwarded to the DHCP server. The DHCP server then extracts the gateway address from each request and assigns an available IP address within the corresponding IP sub-net (Figure 6.12). The IP address is then forwarded back to the workstation that originated the request.

NOTE: The DHCP relay function of the connecting router needs to be turned on.

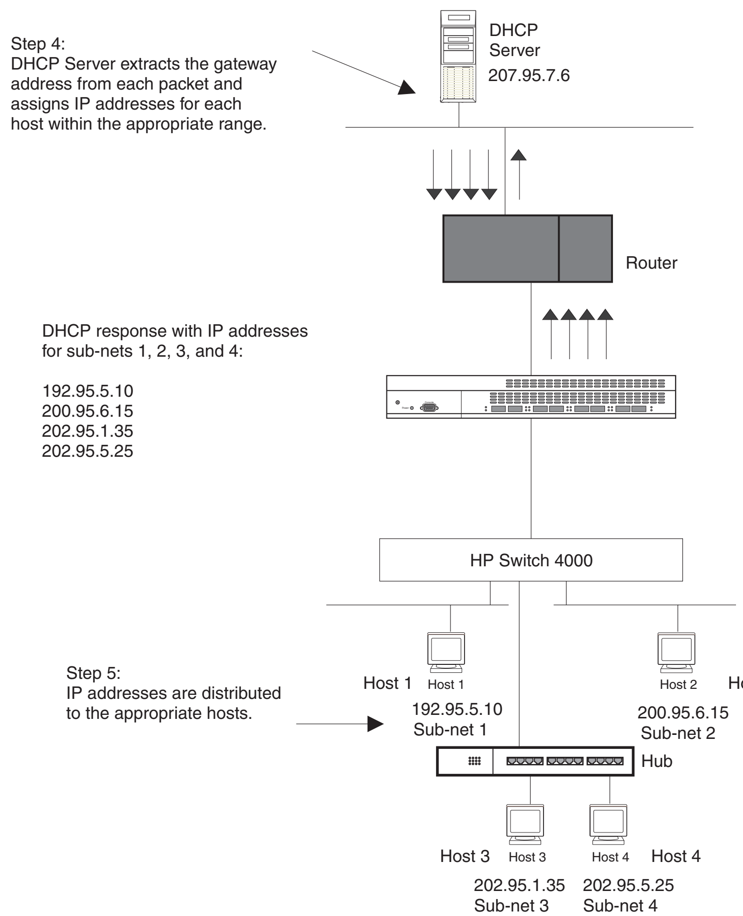


Figure 6.12 DHCP offers are forwarded back toward the requestors

Configuring DHCP Assist

You can associate a gateway list with a port. You must configure a gateway list when DHCP Assist is enabled on the HP 6208M-SX. The gateway list contains a gateway address for each sub-net that will be requesting addresses from a DHCP server. The list allows the stamping process to occur. Each gateway address defined on the switch corresponds to an IP address of the HP routing switch interface or other router involved.

Up to eight addresses can be defined for each gateway list in support of ports that are multi-homed. When multiple IP addresses are configured for a gateway list, the switch inserts the addresses into the discovery packet in a round robin fashion.

Up to 32 gateway lists can be defined for each switch.

USING THE CLI

EXAMPLE:

To create the configuration indicated in Figure 6.11 and Figure 6.12:

```
HP6208(config)# dhcp-gateway-list 1 192.95.5.1
HP6208(config)# dhcp-gateway-list 2 200.95.6.1
HP6208(config)# dhcp-gateway-list 3 202.95.1.1 202.95.5.1
HP6208(config)# int e 2
HP6208(config-if-2)# dhcp-gateway-list 1
HP6208(config-if-2)# dhcp-gateway-list 2
HP6208(config-if-2)# dhcp-gateway-list 3
```

Syntax: dhcp-gateway-list <num> <ip-addr>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Select the DHCP Gateway link to display the DHCP Gateway configuration panel.
3. Enter the list ID in the List ID field. You can specify a number from 1 – 32.
4. Enter up to eight gateway IP address in the IP address fields.
5. Click the Add button to save the change to the device’s running-config file.
6. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Displaying IP Configuration Information and Statistics

The following sections describe IP display options for HP ProCurve routing switches and the HP 6208M-SX switch.

- To display IP information on a routing switch, see “Displaying IP Information – Routing Switches” on page 6-80.
- To display IP information on a switch, see “Displaying IP Information – HP 6208M-SX” on page 6-100.

Changing the Network Mask Display to Prefix Format

By default, the CLI displays network masks in classical IP address format (example: 255.255.255.0). You can change the displays to prefix format (example: /18) on a routing switch or switch using the following CLI method.

NOTE: This option does not affect how information is displayed in the Web management interface.

USING THE CLI

To enable CIDR format for displaying network masks, entering the following command at the global CONFIG level of the CLI:

```
HP9300(config)# ip show-subnet-length
```

Syntax: [no] ip show-subnet-length

USING THE WEB MANAGEMENT INTERFACE

You cannot configure this option using the Web management interface.

Displaying IP Information – Routing Switches

You can display the following IP configuration information statistics on routing switches:

- Global IP parameter settings and IP access policies – see “Displaying Global IP Configuration Information” on page 6-81.
- IP interfaces – see “Displaying IP Interface Information” on page 6-83.
- ARP entries – see “Displaying ARP Entries” on page 6-85.
- Static ARP entries – see “Displaying ARP Entries” on page 6-85.
- IP forwarding cache – see “Displaying the Forwarding Cache” on page 6-88.
- IP route table – see “Displaying the IP Route Table” on page 6-90.
- IP traffic statistics – see “Displaying IP Traffic Statistics” on page 6-93.

The sections below describe how to display this information.

In addition to the information described below, you can display the following IP information. This information is described in other parts of this guide.

- RIP information – see “Displaying RIP Filters” on page 7-16.
- OSPF information – see “Displaying OSPF Information” on page 8-39.
- BGP4 information – see “Displaying BGP4 Information” on page 10-84.
- DVMRP information – see the “Show Commands” chapter in the *Command Line Interface Reference*.
- PIM information – see the “Show Commands” chapter in the *Command Line Interface Reference*.
- VRRP or VRRPE information – see “Displaying VRRP and VRRPE Information” on page 12-19.
- SRP information – see the “Show Commands” chapter in the *Command Line Interface Reference*.

Displaying Global IP Configuration Information

To display global IP configuration information for the routing switch, use one of the following methods.

USING THE CLI

To display IP configuration information, enter the following command at any CLI level:

```
HP9300> show ip

Global Settings
  ttl: 64, arp-age: 10, bootp-relay-max-hops: 4
  router-id : 207.95.11.128
  enabled : UDP-Broadcast-Forwarding  IRDP  Proxy-ARP  RARP  OSPF
  disabled: BGP4 Load-Sharing  RIP  DVMRP  SRP  VRRP

Static Routes
  Index   IP Address        Subnet Mask       Next Hop Router   Metric Distance
  1       0.0.0.0           0.0.0.0           209.157.23.2      1      1

Policies
  Index   Action   Source           Destination      Protocol   Port  Operator
  1       deny     209.157.22.34    209.157.22.26    tcp        http  =
  64      permit   any              any
```

Syntax: show ip

NOTE: This command has additional options, which are explained in other sections in this guide, including the sections below this one.

This display shows the following information.

Table 6.8: CLI Display of Global IP Configuration Information – routing switch

This Field...	Displays...
Global settings	
ttl	The Time-To-Live (TTL) for IP packets. The TTL specifies the maximum number of router hops a packet can travel before reaching the HP routing switch. If the packet's TTL value is higher than the value specified in this field, the HP routing switch drops the packet. To change the maximum TTL, see "Changing the TTL Threshold" on page 6-32.
arp-age	The ARP aging period. This parameter specifies how many minutes an inactive ARP entry remains in the ARP cache before the routing switch ages out the entry. To change the ARP aging period, see "Changing the ARP Aging Period" on page 6-28.
bootp-relay-max-hops	The maximum number of hops away a BootP server can be located from the HP routing switch and still be used by the routing switch's clients for network booting. To change this value, see "Changing the Maximum Number of Hops to a BootP Relay Server" on page 6-72.
router-id	The 32-bit number that uniquely identifies the HP routing switch. By default, the router ID is the numerically lowest IP interface configured on the routing switch. To change the router ID, see "Changing the Router ID" on page 6-25.
enabled	The IP-related protocols that are enabled on the routing switch.
disabled	The IP-related protocols that are disabled on the routing switch.
Static routes	
Index	The row number of this entry in the IP route table.
IP Address	The IP address of the route's destination.
Subnet Mask	The network mask for the IP address.
Next Hop Router	The IP address of the router interface to which the HP routing switch sends packets for the route.
Metric	The cost of the route. Usually, the metric represents the number of hops to the destination.
Distance	The administrative distance of the route. The default administrative distance for static IP routes in HP routing switches is 1. To list the default administrative distances for all types of routes or to change the administrative distance of a static route, see "Changing Administrative Distances" on page 10-30.

Table 6.8: CLI Display of Global IP Configuration Information – routing switch (Continued)

This Field...	Displays...
Policies	
Index	The policy number. This is the number you assigned the policy when you configured it.
Action	The action the routing switch takes if a packet matches the comparison values in the policy. The action can be one of the following: • deny – The routing switch drops packets that match this policy. • permit – The routing switch forwards packets that match this policy.
Source	The source IP address the policy matches.
Destination	The destination IP address the policy matches.
Protocol	The IP protocol the policy matches. The protocol can be one of the following: • ICMP • IGMP • IGRP • OSPF • TCP • UDP
Port	The Layer 4 TCP or UDP port the policy checks for in packets. The port can be displayed by its number or, for port types the routing switch recognizes, by the well-known name. For example, TCP port 80 can be displayed as HTTP. **Note**: This field applies only if the IP protocol is TCP or UDP.
Operator	The comparison operator for TCP or UDP port names or numbers. **Note**: This field applies only if the IP protocol is TCP or UDP.

USING THE WEB MANAGEMENT INTERFACE

You cannot display global IP configuration information using the Web management interface.

Displaying IP Interface Information

To display IP interface information, use one of the following methods.

USING THE CLI

To display IP interface information, enter the following command at any CLI level:

```
HP9300(config)# show ip interface

Interface       IP-Address      OK?  Method    Status                   Protocol
Ethernet 1/1    207.95.6.173    YES  NVRAM     up                       up
Ethernet 1/2    3.3.3.3         YES  manual    up                       up
```

```
Loopback 1      1.2.3.4          YES  NVRAM     down                    down
```

Syntax: show ip interface [ethernet <portnum>] | [loopback <num>] | [ve <num>]

This display shows the following information.

Table 6.9: CLI Display of Interface IP Configuration Information

This Field...	Displays...
Interface	The type and the slot and port number of the interface.
IP-Address	The IP address of the interface. **Note**: If an “s” is listed following the address, this is a secondary address. When the address was configured, the interface already had an IP address in the same sub-net, so the software required the “secondary” option before the software could add the interface.
OK?	Whether the IP address has been configured on the interface.
Method	Whether the IP address has been saved in NVRAM. If you have set the IP address for the interface in the CLI or Web Management interface, but have not saved the configuration, the entry for the interface in the Method field is “manual”.
Status	The link status of the interface. If you have disabled the interface with the **disable** command, the entry in the Status field will be “administratively down”. Otherwise, the entry in the Status field will be either “up” or “down”.
Protocol	Whether the interface can provide two-way communication. If the IP address is configured, and the link status of the interface is up, the entry in the protocol field will be “up”. Otherwise the entry in the protocol field will be “down”.

USING THE WEB MANAGEMENT INTERFACE

To display IP interface information:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the Interface link to display the IP interface table.

This display shows the following information.

Table 6.10: Web Display of IP Interface Information

This Field...	Displays...
Port #	The physical port number or virtual interface (VE) number. VEs are shown as “v<num>”, where <num> is the number you assigned to the VE when you configured it. For example, VE 1 is shown as “v1”. If a range of ports is listed in this field, the interface is a trunk group. If two ranges of ports are listed, the interface is a trunk group that spans multiple chassis modules.
Encapsulation	The frame type used to encapsulate packets on this interface. The frame type is always Ethernet II.
MTU	The Maximum Transmission Unit (MTU), which specifies the maximum packet size for packets sent and received on this interface.
Metric	The cost associated with this interface.
Directed Broadcast Forward	The state of the directed broadcast forwarding feature. The state can be one of the following: • Disable • Enable To change the state of this feature, see “Enabling Forwarding of Directed Broadcasts” on page 6-32.

Displaying ARP Entries

You can display the ARP cache and the static ARP table. The ARP cache contains entries for devices attached to the routing switch. The static ARP table contains the user-configured ARP entries. An entry in the static ARP table enters the ARP cache when the entry’s interface comes up.

The tables require separate display commands or Web management options.

Displaying the ARP Cache

To display the ARP cache, use one of the following methods.

USING THE CLI

To display the contents of the ARP cache, enter the following command at any CLI level:

```
HP9300# show arp

Total number of ARP entries: 5
     IP Address          MAC Address         Type        Age      Port
1      207.95.6.102        0800.5afc.ea21      Dynamic     0          6
2      207.95.6.18         00a0.24d2.04ed      Dynamic     3          6
3      207.95.6.54         00a0.24ab.cd2b      Dynamic     0          6
4      207.95.6.101        0800.207c.a7fa      Dynamic     0          6
5      207.95.6.211        00c0.2638.ac9c      Dynamic     0          6
```

Syntax: show arp [ethernet <portnum> | mac-address <xxxx.xxxx.xxxx> [<mask>] | <ip-addr> [<ip-mask>]] [<num>]

The **ethernet** <portnum> parameter lets you restrict the display to entries for a specific port.

The **mac-address** <xxxx.xxxx.xxxx> parameter lets you restrict the display to entries for a specific MAC address.

The <mask> parameter lets you specify a mask for the **mac-address** <xxxx.xxxx.xxxx> parameter, to display entries for multiple MAC addresses. Specify the MAC address mask as "f"s and "0"s, where "f"s are significant bits.

The <ip-addr> and <ip-mask> parameters let you restrict the display to entries for a specific IP address and network mask. Specify the IP address masks in standard decimal mask format (for example, 255.255.0.0).

NOTE: The <ip-mask> parameter and <mask> parameter perform different operations. The <ip-mask> parameter specifies the network mask for a specific IP address, whereas the <mask> parameter provides a filter for displaying multiple MAC addresses that have specific values in common.

The <num> parameter lets you display the table beginning with a specific entry number.

NOTE: The entry numbers in the ARP cache are not related to the entry numbers for static ARP table entries.

This display shows the following information. The number in the left column of the CLI display is the row number of the entry in the ARP cache. This number is not related to the number you assign to static MAC entries in the static ARP table.

Table 6.11: CLI Display of ARP Cache

This Field...	Displays...
IP Address	The IP address of the device.
MAC Address	The MAC address of the device.
Type	The type, which can be one of the following: • Dynamic – The routing switch learned the entry from an incoming packet. • Static – The routing switch loaded the entry from the static ARP table when the device for the entry was connected to the routing switch.
Age	The number of minutes the entry has remained unused. If this value reaches the ARP aging period, the entry is removed from the table. To display the ARP aging period, see "Displaying Global IP Configuration Information" on page 6-81. To change the ARP aging interval, see "Changing the ARP Aging Period" on page 6-28. **Note**: Static entries do not age out.
Port	The port on which the entry was learned.

USING THE WEB MANAGEMENT INTERFACE

To display the IP ARP cache:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to list the monitoring options.
3. Click on the <u>ARP Cache</u> link to display the IP ARP cache.

This display shows the following information.

Table 6.12: Web Display of ARP Cache – routing switch

This Field...	Displays...
Node	The IP address of the device.
MAC Address	The MAC address of the device.
Type	The type, which can be one of the following: • Dynamic – The routing switch learned the entry from an incoming packet. • Static – The routing switch loaded the entry from the static ARP table when the device for the entry was connected to the routing switch.
Age	The number of minutes the entry has remained unused. If this value reaches the ARP aging period, the entry is removed from the cache. To display the ARP aging period, see "Displaying Global IP Configuration Information" on page 6-81. To change the ARP aging interval, see "Changing the ARP Aging Period" on page 6-28. **Note**: Static entries do not age out.
Port	The port attached to the device the entry is for. For dynamic entries, this is the port on which the entry was learned.

Displaying the Static ARP Table

To display the static ARP table instead of the ARP cache, use either of the following methods.

USING THE CLI

To display the static ARP table, enter the following command at any CLI level:

```
HP9300# show ip static-arp

Static ARP table size: 512, configurable from 512 to 1024
 Ind ex   IP Address      MAC Addr     ess          Port
 1      207.95.6.11   1        0800.093b.d210      1/1
 3      207.95.6.12   3        0800.093b.d211      1/1
```

This example shows two static entries. Note that since you specify an entry's index number when you create the entry, it is possible for the range of index numbers to have gaps, as shown in this example.

NOTE: The entry number you assign to a static ARP entry is not related to the entry numbers in the ARP cache.

Syntax: show ip static-arp [ethernet <portnum> | mac-address <xxxx.xxxx.xxxx> [<mask>] | <ip-addr> [<ip-mask>]] [<num>]

The **ethernet** <portnum> parameter lets you restrict the display to entries for a specific port.

The **mac-address** <xxxx.xxxx.xxxx> parameter lets you restrict the display to entries for a specific MAC address.

The <mask> parameter lets you specify a mask for the **mac-address** <xxxx.xxxx.xxxx> parameter, to display entries for multiple MAC addresses. Specify the MAC address mask as "f"s and "0"s, where "f"s are significant bits.

The <ip-addr> and <ip-mask> parameters let you restrict the display to entries for a specific IP address and network mask. Specify the IP address masks in standard decimal mask format (for example, 255.255.0.0).

NOTE: The <ip-mask> parameter and <mask> parameter perform different operations. The <ip-mask> parameter specifies the network mask for a specific IP address, whereas the <mask> parameter provides a filter for displaying multiple MAC addresses that have specific values in common.

The <num> parameter lets you display the table beginning with a specific entry number.

Table 6.13: CLI Display of Static ARP Table

This Field...	Displays...
Static ARP table size	The maximum number of static entries that can be configured on the device using the current memory allocation. The range of valid memory allocations for static ARP entries is listed after the current allocation. To change the memory allocation for static ARP entries, see "Changing the Maximum Number of Entries the Static ARP Table Can Hold" on page 6-31.
Index	The number of this entry in the table. You specify the entry number when you create the entry.
IP Address	The IP address of the device.
MAC Address	The MAC address of the device.
Port	The port attached to the device the entry is for.

USING THE WEB MANAGEMENT INTERFACE

You cannot display the static ARP table using the Web management interface.

Displaying the Forwarding Cache

To display the IP forwarding cache, use one of the following methods.

NOTE: To display only the forwarding cache entries for aggregated default network routes, see "Displaying the Forwarding Cache Entries for Default Routes" on page 6-61.

USING THE CLI

To display the IP forwarding cache, enter the following command at any CLI level:

```
HP9300> show ip cache

Total number of cache entries: 3
D:Dynamic  P:Permanent  F:Forward  U:Us  C:Complex Filter
W:Wait ARP  I:ICMP Deny  K:Drop  R:Fragment  S:Snap Encap
      IP Address       Next Hop         MAC              Type    Port  Vlan  Pri
1     192.168.1.11     DIRECT           0000.0000.0000    PU     n/a       0
2     192.168.1.255    DIRECT           0000.0000.0000    PU     n/a       0
3     255.255.255.255  DIRECT           0000.0000.0000    PU     n/a       0
```

Syntax: show ip cache [<ip-addr>] | [<num>]

The <ip-addr> parameter displays the cache entry for the specified IP address.

The <num> parameter displays the cache beginning with the row following the number you enter. For example, to begin displaying the cache at row 10, enter the following command: **show ip cache 9**.

The **show ip cache** command displays the following information.

Table 6.14: CLI Display of IP Forwarding Cache – routing switch

This Field...	Displays...
IP Address	The IP address of the destination.
Next Hop	The IP address of the next-hop router to the destination. This field contains either an IP address or the value DIRECT. DIRECT means the destination is either directly attached or the destination is an address on this HP device. For example, the next hop for loopback addresses and broadcast addresses is shown as DIRECT.
MAC	The MAC address of the destination. **Note**: If the entry is type U (indicating that the destination is this HP device), the address consists of zeroes.
Type	The type of host entry, which can be one or more of the following: • D – Dynamic • P – Permanent • F – Forward • U – Us • C – Complex Filter • W – Wait ARP • I – ICMP Deny • K – Drop • R – Fragment • S – Snap Encap
Port	The port through which this device reaches the destination. For destinations that are located on this device, the port number is shown as “n/a”.
VLAN	Indicates the VLAN(s) the listed port is in.
Pri	The QoS priority of the port or VLAN.

USING THE WEB MANAGEMENT INTERFACE

To display the IP forwarding cache:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to list the monitoring options.
3. Click on the plus sign next to IP to list the IP monitoring options.
4. Click on the Cache link to display the IP cache.

This display shows the following information.

Table 6.15: Web Display of IP Forwarding Cache Information – routing switch

This Field...	Displays...
IP Address	The IP address of the destination.
Next Hop	The IP address of the next-hop router to the destination. This field contains either an IP address or the value DIRECT. DIRECT means the destination is either directly attached or the destination is an address on this HP device. For example, the next hop for loopback addresses and broadcast addresses is shown as DIRECT.
MAC	The MAC address of the destination. **Note**: If the entry is type U (indicating that the destination is this HP device), the address consists of zeroes.
Type	The type of host entry, which can be one or more of the following: • D – Dynamic • P – Permanent • F – Forward • U – Us • C – Complex Filter • W – Wait ARP • I – ICMP Deny • K – Drop • R – Fragment • S – Snap Encap
Action	This information is used by HP customer support.
Flag Check	This information is used by HP customer support.
Snap	This information is used by HP customer support.
Port	The port through which this device reaches the destination. For destinations that are located on this device, the port number is shown as “n/a”.
VLAN	Indicates the VLAN(s) the listed port is in.
Priority	The QoS priority of the port or VLAN.

Displaying the IP Route Table

To display the IP route table, use one of the following methods.

USING THE CLI

To display the IP route table, enter the following command at any CLI level:

```
HP9300> show ip route

Total number of IP routes: 514
```

```
Start index: 1  B:BGP D:Connected  R:RIP  S:Static  O:OSPF *:Candidate default

Destination       NetMask           Gateway           Port   Cost   Type
1.1.0.0           255.255.0.0       99.1.1.2          1/1    2      R
1.2.0.0           255.255.0.0       99.1.1.2          1/1    2      R
1.3.0.0           255.255.0.0       99.1.1.2          1/1    2      R
1.4.0.0           255.255.0.0       99.1.1.2          1/1    2      R
1.5.0.0           255.255.0.0       99.1.1.2          1/1    2      R
1.6.0.0           255.255.0.0       99.1.1.2          1/1    2      R
1.7.0.0           255.255.0.0       99.1.1.2          1/1    2      R
1.8.0.0           255.255.0.0       99.1.1.2          1/1    2      R
1.9.0.0           255.255.0.0       99.1.1.2          1/1    2      R
1.10.0.0          255.255.0.0       99.1.1.2          1/1    2      S
```

Syntax: show ip route [<ip-addr> [<ip-mask>] [longer]] | <num> | bgp | direct | ospf | rip | static]

The <ip-addr> parameter displays the route to the specified IP address.

The <ip-mask> parameter lets you specify a network mask or, if you prefer CIDR format, the number of bits in the network mask. If you use CIDR format, enter a forward slash immediately after the IP address, then enter the number of mask bits (for example: 209.157.22.0/24 for 209.157.22.0 255.255.255.0).

The **longer** parameter applies only when you specify an IP address and mask. This option displays only the routes for the specified IP address and mask. See the example below.

The <num> option display the route table entry whose row number corresponds to the number you specify. For example, if you want to display the tenth row in the table, enter "10".

The **bgp** option displays the BGP4 routes.

The **direct** option displays only the IP routes that are directly attached to the routing switch.

The **ospf** option displays the OSPF routes.

The **rip** option displays the RIP routes.

The **static** option displays only the static IP routes.

Here is an example of how to use the **direct** option. To display only the IP routes that go to devices directly attached to the routing switch:

```
HP9300(config)# show ip route direct
Start index: 1  B:BGP D:Connected  R:RIP  S:Static  O:OSPF *:Candidate default

      Destination       NetMask           Gateway           Port   Cost   Type
      209.157.22.0      255.255.255.0     0.0.0.0           4/11   1      D
```

Notice that the route displayed in this example has "D" in the Type field, indicating the route is to a directly connected device.

Here is an example of how to use the **static** option. To display only the static IP routes:

```
HP9300(config)# show ip route static
Start index: 1  B:BGP D:Connected  R:RIP  S:Static  O:OSPF *:Candidate default

      Destination       NetMask           Gateway           Port   Cost   Type
      192.144.33.11     255.255.255.0     209.157.22.12     1/1    2      S
```

Notice that the route displayed in this example has "S" in the Type field, indicating the route is static.

Here is an example of how to use the **longer** option. To display only the routes for a specified IP address and mask, enter a command such as the following:

```
HP9300(config)# show ip route 209.159.0.0/16 longer

Starting index: 1 B:BGP D:Directly-Connected R:RIP S:Static O:OSPF
Destination NetMask Gateway Port Cost Type

52 209.159.38.0 255.255.255.0 207.95.6.101 1/1 1 S
```

```
53 209.159.39.0 255.255.255.0 207.95.6.101 1/1 1 S
54 209.159.40.0 255.255.255.0 207.95.6.101 1/1 1 S
55 209.159.41.0 255.255.255.0 207.95.6.101 1/1 1 S
56 209.159.42.0 255.255.255.0 207.95.6.101 1/1 1 S
57 209.159.43.0 255.255.255.0 207.95.6.101 1/1 1 S
58 209.159.44.0 255.255.255.0 207.95.6.101 1/1 1 S
59 209.159.45.0 255.255.255.0 207.95.6.101 1/1 1 S
60 209.159.46.0 255.255.255.0 207.95.6.101 1/1 1 S
```

This example shows all the routes for networks beginning with 209.159. The mask value and **longer** parameter specify the range of network addresses to be displayed. In this example, all routes within the range 209.159.0.0 – 209.159.255.255 are listed.

The following table lists the information displayed by the **show ip route** command.

Table 6.16: CLI Display of IP Route Table

This Field...	Displays...
Destination	The destination network of the route.
NetMask	The network mask of the destination address.
Gateway	The next-hop router.
Port	The port through which this router sends packets to reach the route's destination.
Cost	The route's cost.

Type	The route type, which can be one of the following:
	• B – The route was learned from BGP.
	• D – The destination is directly connected to this routing switch.
	• R – The route was learned from RIP.
	• S – The route is a static route.
	• * – The route is a candidate default route.
	• O – The route is an OSPF route. Unless you use the **ospf** option to display the route table, “O” is used for all OSPF routes. If you do use the **ospf** option, the following type codes are used:
	  • O – OSPF intra area route (within the same area).
	  • IA – The route is an OSPF inter area route (a route that passes from one area into another).
	  • E1 – The route is an OSPF external type 1 route.
	  • E2 – The route is an OSPF external type 2 route.

USING THE WEB MANAGEMENT INTERFACE

To display the IP route table:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to list the monitoring options.
3. Click on the plus sign next to IP to list the IP monitoring options.
4. Click on the Routing Table link to display the table.

Clearing IP Routes

If needed, you can clear the entire route table or specific individual routes. To do so, use one of the following procedures.

USING THE CLI

To clear all routes from the IP route table:

```
HP9300# clear ip route
```

To clear route 209.157.22.0/24 from the IP routing table:

```
HP9300# clear ip route 209.157.22.0/24
```

Syntax: clear ip route [<ip-addr> <ip-mask>]

or

Syntax: clear ip route [<ip-addr>/<mask-bits>]

USING THE WEB MANAGEMENT INTERFACE

The Web management interface does not allow you to selectively clear routes in the IP routing table, but does allow you to clear all routes from the IP routing table.

To clear all routes from the IP route table:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Command in the tree view to expand the list of command options.
3. Click on the Clear link to display the Clear panel.
4. Select the box next to IP Route.
5. Click Apply.

Displaying IP Traffic Statistics

To display IP traffic statistics, use one of the following methods.

USING THE CLI

To display IP traffic statistics, enter the following command at any CLI level:

```
HP9300> show ip traffic

IP Statistics

  139 received, 145 sent, 0 forwarded
  0 filtered, 0 fragmented, 0 reassembled, 0 bad header
  0 no route, 0 unknown proto, 0 no buffer, 0 other errors

ICMP Statistics
Received:
  0 total, 0 errors, 0 unreachable, 0 time exceed
  0 parameter, 0 source quench, 0 redirect, 0 echo,
  0 echo reply, 0 timestamp, 0 timestamp reply, 0 addr mask
  0 addr mask reply, 0 irdp advertisement, 0 irdp solicitation
Sent:
  0 total, 0 errors, 0 unreachable, 0 time exceed
  0 parameter, 0 source quench, 0 redirect, 0 echo,
  0 echo reply, 0 timestamp, 0 timestamp reply, 0 addr mask
  0 addr mask reply, 0 irdp advertisement, 0 irdp solicitation

UDP Statistics
  1 received, 0 sent, 1 no port, 0 input errors
```

```
TCP Statistics
  0 active opens, 0 passive opens, 0 failed attempts
  0 active resets, 0 passive resets, 0 input errors
  138 in segments, 141 out segments, 4 retransmission

RIP Statistics
  0 requests sent, 0 requests received
  0 responses sent, 0 responses received
  0 unrecognized, 0 bad version, 0 bad addr family, 0 bad req format
  0 bad metrics, 0 bad resp format, 0 resp not from rip port
  0 resp from loopback, 0 packets rejected
```

The **show ip traffic** command displays the following information.

Table 6.17: CLI Display of IP Traffic Statistics – routing switch

This Field...	Displays...
IP statistics	
received	The total number of IP packets received by the device.
sent	The total number of IP packets originated and sent by the device.
forwarded	The total number of IP packets received by the device and forwarded to other devices.
filtered	The total number of IP packets filtered by the device.
fragmented	The total number of IP packets fragmented by this device to accommodate the MTU of this device or of another device.
reassembled	The total number of fragmented IP packets that this device re-assembled.
bad header	The number of IP packets dropped by the device due to a bad packet header.
no route	The number of packets dropped by the device because there was no route.
unknown proto	The number of packets dropped by the device because the value in the Protocol field of the packet header is unrecognized by this device.
no buffer	This information is used by HP customer support.
other errors	The number of packets that this device dropped due to error types other than the types listed above.
ICMP statistics The ICMP statistics are derived from RFC 792, “Internet Control Message Protocol”, RFC 950, “Internet Standard Subnetting Procedure”, and RFC 1256, “ICMP Router Discovery Messages”. Statistics are organized into Sent and Received. The field descriptions below apply to each.	
total	The total number of ICMP messages sent or received by the device.
errors	This information is used by HP customer support.
unreachable	The number of Destination Unreachable messages sent or received by the device.
time exceed	The number of Time Exceeded messages sent or received by the device.

Table 6.17: CLI Display of IP Traffic Statistics – routing switch (Continued)

This Field...	Displays...
parameter	The number of Parameter Problem messages sent or received by the device.
source quench	The number of Source Quench messages sent or received by the device.
redirect	The number of Redirect messages sent or received by the device.
echo	The number of Echo messages sent or received by the device.
echo reply	The number of Echo Reply messages sent or received by the device.
timestamp	The number of Timestamp messages sent or received by the device.
timestamp reply	The number of Timestamp Reply messages sent or received by the device.
addr mask	The number of Address Mask Request messages sent or received by the device.
addr mask reply	The number of Address Mask Replies messages sent or received by the device.
irdp advertisement	The number of ICMP Router Discovery Protocol (IRDP) Advertisement messages sent or received by the device.
irdp solicitation	The number of IRDP Solicitation messages sent or received by the device.
UDP statistics	
received	The number of UDP packets received by the device.
sent	The number of UDP packets sent by the device.
no port	The number of UDP packets dropped because the packet did not contain a valid UDP port number.
input errors	This information is used by HP customer support.
TCP statistics The TCP statistics are derived from RFC 793, “Transmission Control Protocol”.	
active opens	The number of TCP connections opened by this device by sending a TCP SYN to another device.
passive opens	The number of TCP connections opened by this device in response to connection requests (TCP SYNs) received from other devices.
failed attempts	This information is used by HP customer support.
active resets	The number of TCP connections this device reset by sending a TCP RESET message to the device at the other end of the connection.
passive resets	The number of TCP connections this device reset because the device at the other end of the connection sent a TCP RESET message.
input errors	This information is used by HP customer support.
in segments	The number of TCP segments received by the device.

Table 6.17: CLI Display of IP Traffic Statistics – routing switch (Continued)

This Field...	Displays...
out segments	The number of TCP segments sent by the device.
retransmission	The number of segments that this device retransmitted because the retransmission timer for the segment had expired before the device at the other end of the connection had acknowledged receipt of the segment.
RIP statistics The RIP statistics are derived from RFC 1058, "Routing Information Protocol".	
requests sent	The number of requests this device has sent to another RIP router for all or part of its RIP routing table.
requests received	The number of requests this device has received from another RIP router for all or part of this device's RIP routing table.
responses sent	The number of responses this device has sent to another RIP router's request for all or part of this device's RIP routing table.
responses received	The number of responses this device has received to requests for all or part of another RIP router's routing table.
unrecognized	This information is used by HP customer support.
bad version	The number of RIP packets dropped by the device because the RIP version was either invalid or is not supported by this device.
bad addr family	The number of RIP packets dropped because the value in the Address Family Identifier field of the packet's header was invalid.
bad req format	The number of RIP request packets this router dropped because the format was bad.
bad metrics	This information is used by HP customer support.
bad resp format	The number of responses to RIP request packets this router dropped because the format was bad.
resp not from rip port	This information is used by HP customer support.
resp from loopback	The number of RIP responses received from loopback interfaces.
packets rejected	This information is used by HP customer support.

USING THE WEB MANAGEMENT INTERFACE

To display IP traffic statistics:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to list the monitoring options.
3. Click on the plus sign next to IP to list the IP monitoring options.
4. Click on the Traffic link to display the table.

This display shows the following information.

Table 6.18: Web Display of IP Traffic Statistics – routing switch

This Field...	Displays...
IP statistics	
Packets Received	The number of IP packets received by the device.
Packets Sent	The number of IP packets originated and sent by the device.
Packets Forwarded	The number of IP packets received from another device and forwarded by this device.
Filtered	The number of IP packets filtered by this device.
Fragmented	The number of IP packets fragmented by this device before sending or forwarding them.
Reassembled	The number of fragmented IP packets received and re-assembled by the device.
Bad Header	The number of packets dropped because they had a bad header.
No Route	The number of packets dropped because they had no route information.
Unknown Protocols	The number of packets dropped because they were using an unknown protocol.
No Buffer	The number of packets dropped because the device ran out of buffer space.
Other Errors	The number of packets dropped due to errors other than the ones listed above.
ICMP statistics	
Total Received	The number of ICMP packets received by the device.
Total Sent	The number of ICMP packets sent by the device.
Received Errors	This information is used by HP customer support.
Sent Errors	This information is used by HP customer support.
Received Unreachable	The number of Destination Unreachable messages received by the device.
Sent Unreachable	The number of Destination Unreachable messages sent by the device.
Received Time Exceed	The number of Time Exceeded messages received by the device.
Sent Time Exceed	The number of Time Exceeded messages sent by the device.
Received Parameter	The number of Parameter Problem messages received by the device.
Sent Parameter	The number of Parameter Problem messages sent by the device.
Received Source Quench	The number of Source Quench messages received by the device.
Sent Source Quench	The number of Source Quench messages sent by the device.

Table 6.18: Web Display of IP Traffic Statistics – routing switch (Continued)

This Field...	Displays...
Received Redirect	The number of Redirect messages received by the device.
Sent Redirect	The number of Redirect messages sent by the device.
Received Echo	The number of Echo messages received by the device.
Sent Echo	The number of Echo messages sent by the device.
Received Echo Reply	The number of Echo messages received by the device.
Sent Echo Reply	The number of Echo messages sent by the device.
Received Timestamp	The number of Timestamp messages received by the device.
Sent Timestamp	The number of Timestamp messages sent by the device.
Received Timestamp Reply	The number of Timestamp Reply messages received by the device.
Sent Timestamp Reply	The number of Timestamp Reply messages sent by the device.
Received Address Mask	The number of Address Mask Request messages received by the device.
Sent Address Mask	The number of Address Mask Request messages sent by the device.
Received Address Mask Reply	The number of Address Mask Replies messages received by the device.
Sent Address Mask Reply	The number of Address Mask Replies messages sent by the device.
Received IRDP Advertisement	The number of ICMP Router Discovery Protocol (IRDP) Advertisement messages received by the device.
Sent IRDP Advertisement	The number of IRDP Advertisement messages sent by the device.
Received IRDP Solicitation	The number of IRDP Solicitation messages received by the device.
Sent IRDP Solicitation	The number of IRDP Solicitation messages sent by the device.
UDP statistics	
Received	The number of UDP packets received by the device.
Sent	The number of UDP packets sent by the device.
No Port	The number of UDP packets dropped because the packet did not contain a valid UDP port number.
Input Errors	This information is used by HP customer support.
TCP statistics The TCP statistics are derived from RFC 793, “Transmission Control Protocol”.	
Active Opens	The number of TCP connections opened by this device by sending a TCP SYN to another device.
Passive Opens	The number of TCP connections opened by this device in response to connection requests (TCP SYNs) received from other devices.
Failed Attempts	This information is used by HP customer support.

Table 6.18: Web Display of IP Traffic Statistics – routing switch (Continued)

This Field...	Displays...
Active Resets	The number of TCP connections this device reset by sending a TCP RESET message to the device at the other end of the connection.
Passive Resets	The number of TCP connections this device reset because the device at the other end of the connection sent a TCP RESET message.
Input Errors	This information is used by HP customer support.
In Segments	The number of TCP segments received by the device.
Out Segments	The number of TCP segments sent by the device.
Retransmission	The number of segments that this device retransmitted because the retransmission timer for the segment had expired before the device at the other end of the connection had acknowledged receipt of the segment.
RIP statistics The RIP statistics are derived from RFC 1058, “Routing Information Protocol”.	
Requests Sent	The number of requests this device has sent to another RIP router for all or part of its RIP routing table.
Requests Received	The number of requests this device has received from another RIP router for all or part of this device’s RIP routing table.
Responses Sent	The number of responses this device has sent to another RIP router’s request for all or part of this device’s RIP routing table.
Responses Received	The number of responses this device has received to requests for all or part of another RIP router’s routing table.
Unrecognized	This information is used by HP customer support.
Bad Version	The number of RIP packets dropped by the device because the RIP version was either invalid or is not supported by this device.
Bad Address Family	The number of RIP packets dropped because the value in the Address Family Identifier field of the packet’s header was invalid.
Bad Request Format	The number of RIP request packets this router dropped because the format was bad.
Bad Metrics	This information is used by HP customer support.
Bad Response Format	The number of responses to RIP request packets this router dropped because the format was bad.
Resp Not From RIP Port	This information is used by HP customer support.
Response From Loopback	The number of RIP responses received from loopback interfaces.
Packets Rejected	This information is used by HP customer support.

Displaying IP Information – HP 6208M-SX

You can display the following IP configuration information statistics on the HP 6208M-SX:

- Global IP settings – see "Displaying Global IP Configuration Information" on page 6-100.
- ARP entries – see "Displaying ARP Entries" on page 6-101.
- IP traffic statistics – see "Displaying IP Traffic Statistics" on page 6-102.

Displaying Global IP Configuration Information

To display the switch's IP address and default gateway, use either of the following methods.

USING THE CLI

To display the IP configuration, enter the following command from any level of the CLI:

```
HP6208(config)# show ip

     Switch IP address: 192.168.1.2

           Subnet mask: 255.255.255.0

Default router address: 192.168.1.1
   TFTP server address: None
Configuration filename: None
        Image filename: None
```

Syntax: show ip

This display shows the following information.

Table 6.19: CLI Display of Global IP Configuration Information – switch

This Field...	Displays...
IP configuration	
Switch IP address	The management IP address you configured on the switch. Specify this address for Telnet or Web management access.
Subnet mask	The sub-net mask for the management IP address.
Default router address	The address of the default gateway, if you specified one.
Most recent TFTP access	
TFTP server address	The IP address of the most-recently contacted TFTP server, if the switch has contacted a TFTP server since the last time the software was reloaded or the switch was rebooted.
Configuration filename	The name under which the switch's startup-config file was uploaded or downloaded during the most recent TFTP access.
Image filename	The name of the switch flash image (system software file) that was uploaded or downloaded during the most recent TFTP access.

USING THE WEB MANAGEMENT INTERFACE

To display the management IP address and default gateway:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the list of configuration options.
3. Click on the plus sign next to IP to display the list of IP configuration options.
4. Select the IP Address link to display the IP address configuration panel.

NOTE: You cannot display the TFTP access information using the Web management interface.

Displaying ARP Entries

To display the entries the switch has placed in its ARP cache, use either of the following methods:

USING THE CLI

To display the ARP cache, enter the following command from any level of the CLI:

```
HP6208(config)# show arp

         IP               Mac        Port Age VlanId
192.168.1.170       0010.5a11.d042     7   0      1
Total Arp Entries : 1
```

Syntax: show arp

This display shows the following information.

Table 6.20: CLI Display of ARP Cache

This Field...	Displays...
IP	The IP address of the device.
Mac	The MAC address of the device. **Note**: If the MAC address is all zeros, the entry is for the default gateway, but the switch does not have a link to the gateway.
Port	The port on which the entry was learned.
Age	The number of minutes the entry has remained unused. If this value reaches the ARP aging period, the entry is removed from the cache.
VlanId	The VLAN the port that learned the entry is in. **Note**: If the MAC address is all zeros, this field shows a random VLAN ID, since the switch does not yet know which port the device for this entry is attached to.
Total ARP Entries	The number of entries in the ARP cache.

USING THE WEB MANAGEMENT INTERFACE

To display the ARP cache:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to display the list of configuration options.
3. Select the ARP Cache link to display the ARP cache.

This display shows the following information.

Table 6.21: Web Display of ARP Cache – switch

This Field...	Displays...
Node	The IP address of the device.
MAC Address	The MAC address of the device.
Type	The type, which is always Dynamic on HP switches. The device learns dynamic entries from incoming packet.
Age	The number of minutes the entry has remained unused. If this value reaches the ARP aging period, the entry is removed from the cache.
Port	The port on which the entry was learned.

Displaying IP Traffic Statistics

To display IP traffic statistics on a switch, use one of the following methods.

USING THE CLI

To display IP traffic statistics, enter the following command at any CLI level:

```
HP6208# show ip traffic

IP Statistics
  27 received, 24 sent
  0 fragmented, 0 reassembled, 0 bad header
  0 no route, 0 unknown proto, 0 no buffer, 0 other errors

ICMP Statistics
Received:
  0 total, 0 errors, 0 unreachable, 0 time exceed
  0 parameter, 0 source quench, 0 redirect, 0 echo,
  0 echo reply, 0 timestamp, 0 timestamp rely, 0 addr mask
  0 addr mask reply, 0 irdp advertisement, 0 irdp solicitation
Sent:
  0 total, 0 errors, 0 unreachable, 0 time exceed
  0 parameter, 0 source quench, 0 redirect, 0 echo,
  0 echo reply, 0 timestamp, 0 timestamp rely, 0 addr mask
  0 addr mask reply, 0 irdp advertisement, 0 irdp solicitation

UDP Statistics
  0 received, 0 sent, 0 no port, 0 input errors

TCP Statistics
```

```
 1 current active tcbs, 4 tcbs allocated, 0 tcbs freed 0 tcbs protected
 0 active opens, 0 passive opens, 0 failed attempts
 0 active resets, 0 passive resets, 0 input errors
27 in segments, 24 out segments, 0 retransmission
```

Syntax: show ip traffic

The **show ip traffic** command displays the following information.

Table 6.22: CLI Display of IP Traffic Statistics – switch

This Field...	Displays...
IP statistics	
received	The total number of IP packets received by the device.
sent	The total number of IP packets originated and sent by the device.
fragmented	The total number of IP packets fragmented by this device to accommodate the MTU of this device or of another device.
reassembled	The total number of fragmented IP packets that this device re-assembled.
bad header	The number of IP packets dropped by the device due to a bad packet header.
no route	The number of packets dropped by the device because there was no route.
unknown proto	The number of packets dropped by the device because the value in the Protocol field of the packet header is unrecognized by this device.
no buffer	This information is used by HP customer support.
other errors	The number of packets that this device dropped due to error types other than the types listed above.
ICMP statistics	
The ICMP statistics are derived from RFC 792, “Internet Control Message Protocol”, RFC 950, “Internet Standard Subnetting Procedure”, and RFC 1256, “ICMP Router Discovery Messages”. Statistics are organized into Sent and Received. The field descriptions below apply to each.	
total	The total number of ICMP messages sent or received by the device.
errors	This information is used by HP customer support.
unreachable	The number of Destination Unreachable messages sent or received by the device.
time exceed	The number of Time Exceeded messages sent or received by the device.
parameter	The number of Parameter Problem messages sent or received by the device.
source quench	The number of Source Quench messages sent or received by the device.
redirect	The number of Redirect messages sent or received by the device.

Table 6.22: CLI Display of IP Traffic Statistics – switch (Continued)

This Field...	Displays...
echo	The number of Echo messages sent or received by the device.
echo reply	The number of Echo Reply messages sent or received by the device.
timestamp	The number of Timestamp messages sent or received by the device.
timestamp reply	The number of Timestamp Reply messages sent or received by the device.
addr mask	The number of Address Mask Request messages sent or received by the device.
addr mask reply	The number of Address Mask Replies messages sent or received by the device.
irdp advertisement	The number of ICMP Router Discovery Protocol (IRDP) Advertisement messages sent or received by the device.
irdp solicitation	The number of IRDP Solicitation messages sent or received by the device.
UDP statistics	
received	The number of UDP packets received by the device.
sent	The number of UDP packets sent by the device.
no port	The number of UDP packets dropped because the packet did not contain a valid UDP port number.
input errors	This information is used by HP customer support.
TCP statistics The TCP statistics are derived from RFC 793, “Transmission Control Protocol”.	
current active tcbs	The number of TCP Control Blocks (TCBs) that are currently active.
tcbs allocated	The number of TCBs that have been allocated.
tcbs freed	The number of TCBs that have been freed.
tcbs protected	This information is used by HP customer support.
active opens	The number of TCP connections opened by this device by sending a TCP SYN to another device.
passive opens	The number of TCP connections opened by this device in response to connection requests (TCP SYNs) received from other devices.
failed attempts	This information is used by HP customer support.
active resets	The number of TCP connections this device reset by sending a TCP RESET message to the device at the other end of the connection.
passive resets	The number of TCP connections this device reset because the device at the other end of the connection sent a TCP RESET message.
input errors	This information is used by HP customer support.
in segments	The number of TCP segments received by the device.

Table 6.22: CLI Display of IP Traffic Statistics – switch (Continued)

This Field...	Displays...
out segments	The number of TCP segments sent by the device.
retransmission	The number of segments that this device retransmitted because the retransmission timer for the segment had expired before the device at the other end of the connection had acknowledged receipt of the segment.

USING THE WEB MANAGEMENT INTERFACE

To display IP traffic statistics:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to list the monitoring options.
3. Click on the plus sign next to IP to list the IP monitoring options.
4. Click on the Traffic link to display the table.

This display shows the following information.

Table 6.23: Web Display of IP Traffic Statistics – switch

This Field...	Displays...
IP statistics	
Packets Received	The number of IP packets received by the device.
Packets Sent	The number of IP packets originated and sent by the device.
Fragmented	The number of IP packets fragmented by this device before sending or forwarding them.
Reassembled	The number of fragmented IP packets received and re-assembled by the device.
Bad Header	The number of packets dropped because they had a bad header.
No Route	The number of packets dropped because they had no route information.
Unknown Protocols	The number of packets dropped because they were using an unknown protocol.
No Buffer	The number of packets dropped because the device ran out of buffer space.
Other Errors	The number of packets dropped due to errors other than the ones listed above.
ICMP statistics	
Total Received	The number of ICMP packets received by the device.
Total Sent	The number of ICMP packets sent by the device.
Received Errors	This information is used by HP customer support.

Table 6.23: Web Display of IP Traffic Statistics – switch (Continued)

This Field...	Displays...
Sent Errors	This information is used by HP customer support.
Received Unreachable	The number of Destination Unreachable messages received by the device.
Sent Unreachable	The number of Destination Unreachable messages sent by the device.
Received Time Exceed	The number of Time Exceeded messages received by the device.
Sent Time Exceed	The number of Time Exceeded messages sent by the device.
Received Parameter	The number of Parameter Problem messages received by the device.
Sent Parameter	The number of Parameter Problem messages sent by the device.
Received Source Quench	The number of Source Quench messages received by the device.
Sent Source Quench	The number of Source Quench messages sent by the device.
Received Redirect	The number of Redirect messages received by the device.
Sent Redirect	The number of Redirect messages sent by the device.
Received Echo	The number of Echo messages received by the device.
Sent Echo	The number of Echo messages sent by the device.
Received Echo Reply	The number of Echo messages received by the device.
Sent Echo Reply	The number of Echo messages sent by the device.
Received Timestamp	The number of Timestamp messages received by the device.
Sent Timestamp	The number of Timestamp messages sent by the device.
Received Timestamp Reply	The number of Timestamp Reply messages received by the device.
Sent Timestamp Reply	The number of Timestamp Reply messages sent by the device.
Received Address Mask	The number of Address Mask Request messages received by the device.
Sent Address Mask	The number of Address Mask Request messages sent by the device.
Received Address Mask Reply	The number of Address Mask Replies messages received by the device.
Sent Address Mask Reply	The number of Address Mask Replies messages sent by the device.
Received IRDP Advertisement	The number of ICMP Router Discovery Protocol (IRDP) Advertisement messages received by the device.
Sent IRDP Advertisement	The number of IRDP Advertisement messages sent by the device.
Received IRDP Solicitation	The number of IRDP Solicitation messages received by the device.
Sent IRDP Solicitation	The number of IRDP Solicitation messages sent by the device.

Table 6.23: Web Display of IP Traffic Statistics – switch (Continued)

This Field...	Displays...
UDP statistics	
Received	The number of UDP packets received by the device.
Sent	The number of UDP packets sent by the device.
No Port	The number of UDP packets dropped because the packet did not contain a valid UDP port number.
Input Errors	This information is used by HP customer support.
TCP statistics The TCP statistics are derived from RFC 793, “Transmission Control Protocol”.	
Active Opens	The number of TCP connections opened by this device by sending a TCP SYN to another device.
Passive Opens	The number of TCP connections opened by this device in response to connection requests (TCP SYNs) received from other devices.
Failed Attempts	This information is used by HP customer support.
Active Resets	The number of TCP connections this device reset by sending a TCP RESET message to the device at the other end of the connection.
Passive Resets	The number of TCP connections this device reset because the device at the other end of the connection sent a TCP RESET message.
Input Errors	This information is used by HP customer support.
In Segments	The number of TCP segments received by the device.
Out Segments	The number of TCP segments sent by the device.
Retransmission	The number of segments that this device retransmitted because the retransmission timer for the segment had expired before the device at the other end of the connection had acknowledged receipt of the segment.
Current Active TCBs	The number of TCP Control Blocks (TCBs) that are currently active.
TCBs Allocated	The number of TCBs that have been allocated.
TCBs Freed	The number of TCBs that have been freed.
Keepalive Close Connection	This information is used by HP customer support.
Keepalive Failure Callback	This information is used by HP customer support.
TCP Connect Connection Exist	This information is used by HP customer support.
TCP Connect Out of TCB	This information is used by HP customer support.

Chapter 7
Configuring RIP

Routing Information Protocol (RIP) is an IP route exchange protocol that uses a ***distance vector*** (a number representing distance) to measure the cost of a given route. The ***cost*** is a distance vector because the cost often is equivalent to the number of router hops between the HP routing switch and the destination network.

An HP routing switch can receive multiple paths to a destination. The software evaluates the paths, selects the best path, and saves the path in the IP route table as the route to the destination. Typically, the best path is the path with the fewest hops. A hop is another router through which packets must travel to reach the destination. If the HP routing switch receives a RIP update from another router that contains a path with fewer hops than the path stored in the HP routing switch's route table, the routing switch replaces the older route with the newer one. The routing switch then includes the new path in the updates it sends to other RIP routers, including HP routing switches.

RIP routers, including HP routing switches, also can modify a route's cost, generally by adding to it, to bias the selection of a route for a given destination. In this case, the actual number of router hops may be the same, but the route has an administratively higher cost and is thus less likely to be used than other, lower-cost routes.

A RIP route can have a maximum cost of 15. Any destination with a higher cost is considered unreachable. Although limiting to larger networks, the low maximum hop count prevents endless loops in the network.

HP routing switches support the following RIP types:

- Version 1
- V1 compatible with V2
- Version 2 (the default)

ICMP Host Unreachable Message for Undeliverable ARPs

If the routing switch receives an ARP request packet that it is unable to deliver to the final destination because of the ARP timeout and no ARP response is received (routing switch knows of no route to the destination address), the routing switch sends an ICMP Host Unreachable message to the source.

RIP Parameters and Defaults

The following tables list the RIP parameters, their default values, and where to find configuration information.

RIP Global Parameters

Table 7.1 lists the global RIP parameters and their default values, and indicates where you can find configuration information.

Table 7.1: RIP Global Parameters

Parameter	Description	Default	See page...
RIP state	Routing Information Protocol version 2 **Note**: You can change the RIP version on individual interfaces. See Table 7.2 on page 7-3.	Disabled	7-3
Administrative distance	The administrative distance is a numeric value assigned to each type of route on the router. When the routing switch is selecting from among multiple routes (sometimes of different origins) to the same destination, the routing switch compares the administrative distances of the routes and selects the route with the lowest administrative distance. This parameter applies to routes originated by RIP. The administrative distance stays with a route when it is redistributed into other routing protocols.	120	7-6
Redistribution	RIP can redistribute routes from other routing protocols such as OSPF and BGP4 into RIP. A redistributed route is one that a routing switch learns through another protocol, then distributes into RIP.	Disabled	7-7
Redistribution metric	RIP assigns a RIP metric (cost) to each external route redistributed from another routing protocol into RIP. An external route is a route with at least one hop (packets must travel through at least one other router to reach the destination). This parameter applies to routes that are redistributed from other protocols into RIP.	1 (one)	7-8
Update interval	How often the routing switch sends route updates to its RIP neighbors	30 seconds	7-10
Advertising and learning default routes	The router can advertise default routes to its RIP neighbors and learn default routes from the neighbors. **Note**: You also can enable or disable this parameter on an individual interface basis. See Table 7.2 on page 7-3.	Disabled	7-10
Advertising and learning with specific neighbors	The routing switch learns and advertises RIP routes with all its neighbors by default. You can prevent the routing switch from advertising routes to specific neighbors or learning routes from specific neighbors.	Learning and advertising permitted for all neighbors	7-11

RIP Interface Parameters

Table 7.2 lists the interface-level RIP parameters and their default values, and indicates where you can find configuration information.

.

Table 7.2: RIP Interface Parameters

Parameter	Description	Default	See page...
RIP version	The version of the protocol that is supported on the interface. The version can be one of the following: • Version 1 only • Version 2 only • Version 1, but also compatible with version 2	Version 2 only	7-4
Metric	A numeric cost the router adds to RIP routes learned on the interface. This parameter applies only to RIP routes.	1 (one)	7-5
Advertising and learning of default routes	Locally overrides the global setting. See Table 7.1 on page 7-2.	Disabled	7-10
Loop prevention	The method a router uses to prevent routing loops caused by advertising a route on the same interface as the one on which the router learned the route. • Split horizon – The router does not advertise a route on the same interface as the one on which the router learned the route. • Poison reverse – The router assigns a cost of 16 (“infinite” or “unreachable”) to a route before advertising it on the same interface as the one on which the router learned the route.	Split horizon **Note**: Enabling poison reverse disables split horizon on the interface.	7-12
Advertising and learning specific routes	You can control the routes that a routing switch learns or advertises.	The routing switch learns and advertises all RIP routes on all interfaces.	7-13

Configuring RIP Parameters

Use the following procedures to configure RIP parameters on a system-wide and individual interface basis.

Enabling RIP

RIP is disabled by default. To enable it, use one of the following methods. When you enable RIP, the default RIP version is RIPv2. You can change the RIP version on an individual port basis to RIPv1 or RIPv1 with RIPv2 compatibility if needed.

USING THE CLI

To enable RIP on a routing switch, enter the following commands:

```
HP9300(config)# router rip
HP9300(config-rip-router)# exit
```

```
HP9300(config)# write memory
```

Syntax: [no] router rip

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Select the Enable radio button next to RIP.
3. Click the Apply button to apply the changes to the device's running-config file.
4. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Changing the RIP Type on a Port

When you enable RIP, RIPv2 is enabled on all ports by default. You can change the RIP type to one of the following on an individual port basis:

- Version 1 only
- Version 2 only (the default)
- Version 1, but also compatible with version 2

Use one of the following methods to change the RIP type supported on an individual port.

USING THE CLI

To change the RIP type supported on a port, enter commands such as the following:

```
HP9300(config)# interface ethernet 1/1
HP9300(config-if-1/1)# ip rip v1-only
HP9300(config-if-1/1)# exit
HP9300(config)# write memory
```

Syntax: [no] ip rip v1-only | v1-compatible-v2 | v2-only

USING THE WEB MANAGEMENT INTERFACE

To change the RIP version on an individual port:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Click on the Interface link to display the RIP interface table.
5. Click on the Modify button in the row for the port.
6. Select the RIP version from the pulldown menu. The default is version 2.
7. Click the Apply button to save the change to the device's running-config file.

NOTE: To apply the changes to all RIP interfaces, select the Apply To All Ports button instead of the Apply button.

8. To configure settings for another port, select the port (and slot, if applicable) and go to Step 6.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring Metric Parameters

By default, a routing switch port increases the cost of a RIP route that is learned on the port by one. You can configure individual ports to add more than one to a learned route's cost. In addition, you can configure a RIP offset list to increase the metric for learned or advertised routes based on network address.

Changing the Cost of Routes Learned on a Port

By default, a routing switch port increases the cost of a RIP route that is learned on the port. The routing switch increases the cost by adding one to the route's metric before storing the route.

You can change the amount that an individual port adds to the metric of RIP routes learned on the port. To do so, use either of the following methods.

NOTE: RIP considers a route with a metric of 16 to be unreachable. Use this metric only if you do not want the route to be used. In fact, you can prevent the routing switch from using a specific port for routes learned though that port by setting its metric to 16.

USING THE CLI

To increase the cost a port adds to RIP routes learned in that port, enter commands such as the following:

```
HP9300(config)# interface ethernet 6/1
HP9300(config-if-6/1)# ip metric 5
```

This commands configure port 6/1 to add 5 to the cost of each route learned on the port.

Syntax: ip metric <1-16>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the Interface link to display the interface table.
5. Click on the Modify button in the row for the port.
6. Enter a value from 1 – 16 for the metric.
7. Click the Add button to save the change to the device's running-config file.
8. To configure settings for another port, select the port (and slot, if applicable) and go to step 6.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring a RIP Offset List

A RIP offset list allows you to add to the metric of specific inbound or outbound routes learned or advertised by RIP. RIP offset lists provide a simple method for adding to the cost of specific routes and therefore biasing the routing switch's route selection away from those routes.

An offset list consists of the following parameters:

- An ACL that specifies the routes to which to add the metric.
- The direction:
  - In applies to routes the routing switch learns from RIP neighbors.
  - Out applies to routes the routing switch is advertising to its RIP neighbors.
- The type and number of a specific port to which the offset list applies (optional).

The software adds the offset value to the routing metric (cost) of the routes that match the ACL. If a route matches both a global offset list and an interface-based offset list, the interface-based offset list takes precedence. The interface-based offset list's metric is added to the route in this case.

You can configure up to 24 global RIP offset lists and up to 24 RIP offset lists on each interface.

USING THE CLI

To configure a global RIP offset list, enter commands such as the following:

```
HP9300(config)# access-list 21 deny 160.1.0.0 0.0.255.255
HP9300(config)# access-list 21 permit any
HP9300(config)# router rip
HP9300(config-rip-router)# offset-list 21 out 10
```

The commands in this example configure a standard ACL. The ACL matches on all IP networks except 160.1.x.x. When the routing switch advertises a route that matches ACL 21, the offset list adds 10 to the route's metric.

Syntax: [no] <acl-number-or-name> in | out offset [ethernet <portnum>]

In the following example, the routing switch uses ACL 21 to add 10 to the metric of routes received on Ethernet port 2/1.

```
HP9300(config-rip-router)# offset-list 21 in ethernet 2/1
```

USING THE WEB MANAGEMENT INTERFACE

You cannot configure this option using the Web management interface.

Changing the Administrative Distance

By default, the routing switch assigns the default RIP administrative distance (120) to RIP routes. When comparing routes based on administrative distance, the routing switch selects the route with the lower distance. You can change the administrative distance for RIP routes.

NOTE: See "Changing Administrative Distances" on page 10-30 for a list of the default distances for all route sources.

USING THE CLI

To change the administrative distance for RIP routes, enter a command such as the following:

```
HP9300(config-rip-router)# distance 140
```

This command changes the administrative distance to 140 for all RIP routes.

Syntax: [no] distance <num>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Click on the General link to display the RIP configuration panel, shown in Figure 7.1 on page 7-10.
5. Edit the value in the Distance field.
6. Click the Apply button to save the change to the device's running-config file.
7. To configure settings for another port, select the port (and slot, if applicable) and go to step 5.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring Redistribution

You can configure the routing switch to redistribute routes learned through Open Shortest Path First (OSPF) or Border Gateway Protocol version 4 (BGP4) into RIP. When you redistribute a route from one of these other protocols into RIP, the routing switch can use RIP to advertise the route to its RIP neighbors.

To configure redistribution, perform the following tasks:

- Configure redistribution filters (optional). You can configure filters to permit or deny redistribution for a route based on its origin (OSPF, BGP4, and so on), the destination network address, and the route's metric. You also can configure a filter to set the metric based on these criteria.
- Change the default redistribution metric (optional). The routing switch assigns a RIP metric of one to each redistributed route by default. You can change the default metric to a value up to 16.
- Enable redistribution.

NOTE: Do not enable redistribution until you configure the other redistribution parameters. Otherwise, the routing switch might redistribute routes that you plan to filter or otherwise modify.

Configuring Redistribution Filters

RIP redistribution filters apply to all interfaces. If redistribution is already enabled, the software begins using a redistribution filter as soon as you configure it.

USING THE CLI

To configure a redistribution filter, enter a command such as the following:

```
HP9300(config-rip-router)# deny redistribute 2 all 207.92.0.0 255.255.0.0
```

This command denies redistribution for all incoming routes received from the 207.92.0.0 network.

Syntax: [no] permit | deny redistribute <filter-num> all | bgp | ospf | static <ip-addr> <ip-mask> [match-metric <value> | set-metric <value>]

The <filter-num> specifies the redistribution filter ID.

The **all** parameter applies redistribution to all route types.

The **bgp** parameter applies redistribution to BGP4 routes only.

The **ospf** parameter applies redistribution to OSPF routes only.

The **static** parameter applies redistribution to the static route only.

The <ip-addr> <ip-mask> parameters apply redistribution to the specified network and sub-net address.

The **match-metric** <value> parameter applies redistribution to those routes with a specific metric value; possible values are from 1 – 15.

The **set-metric** <value> parameter sets the RIP metric value that will be applied to those routes imported into RIP.

The following command denies redistribution into RIP for all OSPF routes:

```
HP9300(config-rip-router)# deny redistribute 3 ospf 207.92.0.0 255.255.0.0
```

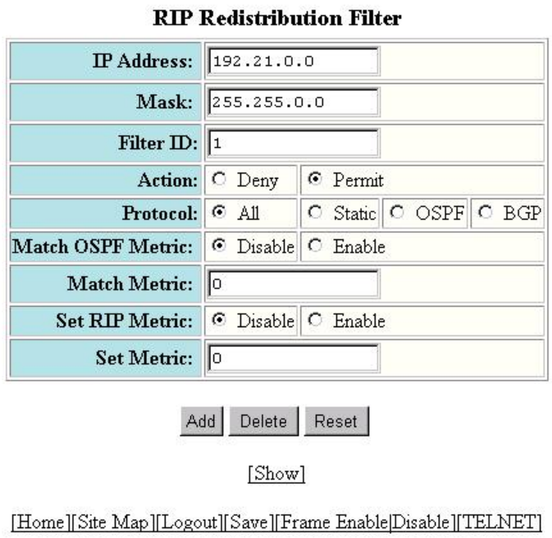
The following command denies redistribution for all OSPF routes that have a metric of 10:

```
HP9300(config-rip-router)# deny redistribute 3 ospf 207.92.0.0 255.255.0.0 match-
metric 10
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.

3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Click on the Redistribution Filter link.
    - If the device does not have any RIP redistribution filters, the RIP Redistribution Filter configuration panel is displayed, as shown in the following example.
    - If a RIP redistribution filter is already configured and you are adding a new filter, click on the Add Redistribution Filter link to display the RIP Neighbor Filter configuration panel, as shown in the following example.
    - If you are modifying an existing RIP redistribution filter, click on the Modify button to the right of the row describing the filter to display the RIP Redistribution Filter configuration panel, as shown in the following example.



5. Enter an IP address and mask to filter on a specific network. You can use zeros (0.0.0.0) instead of a specific interface to allow all IP addresses or mask ranges.
6. Enter the filter ID.
7. Select either Permit or Deny as the action.
8. Select the types of routes you want to filter on next to Protocol.
9. Enable the Match Metric parameter if you want to limit the import of routes to only those that match the metric specified in the Match Metric field.
10. Enable the Set Metric parameter to define and assign a specific metric to an imported route. If enabled, the specified value overrides the default metric defined on the RIP configuration panel.
11. Click the Add button to save the change to the device’s running-config file.
12. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Changing the Redistribution Metric

When the routing switch redistributes a route into RIP, the software assigns a RIP metric (cost) to the route. By default, the software assigns a metric of one to each route that is redistributed into RIP. You can increase the metric that the routing switch assigns, up to 15.

USING THE CLI

To change the RIP metric the routing switch assigns to redistributed routes, enter a command such as the following:

```
HP9300(config-rip-router)# default-metric 10
```

This command assigns a RIP metric of 10 to each route that is redistributed into RIP.

Syntax: [no] default-metric <1-15>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Click on the General link to display the RIP configuration panel, shown in Figure 7.1 on page 7-10.
5. Enter a value from 1 – 15 in the Redistribution Default Metric field.
6. Click the Apply button to save the change to the device's running-config file.
7. To configure settings for another port, select the port (and slot, if applicable) and go to step 5.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Enabling Redistribution

After you configure redistribution parameters, you need to enable redistribution.

USING THE CLI

To enable RIP redistribution, enter the following command:

```
HP9300(config-rip-router)# redistribution
```

Syntax: [no] redistribution

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Click on the General link to display the RIP configuration panel, shown in Figure 7.1 on page 7-10.
5. Select Disable or Enable next to Redistribution.
6. Click the Apply button to save the change to the device's running-config file.
7. To configure settings for another port, select the port (and slot, if applicable) and go to step 5.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring Route Learning and Advertising Parameters

By default, an HP routing switch learns routes from all its RIP neighbors and advertises RIP routes to those neighbors.

You can configure the following learning and advertising parameters:

- Update interval – The update interval specifies how often the routing switch sends RIP route advertisements to its neighbors. The default is 30 seconds. You can change the interval to a value from 1 – 1000 seconds.
- Learning and advertising of RIP default routes – The routing switch learns and advertises RIP default routes by default. You can disable learning and advertising of default routes on a global or individual interface basis.
- Learning of standard RIP routes – By default, the routing switch can learn RIP routes from all its RIP neighbors. You can configure RIP neighbor filters to explicitly permit or deny learning from specific neighbors.

Changing the Update Interval for Route Advertisements

The update interval specifies how often the routing switch sends route advertisements to its RIP neighbors. You can specify an interval from 1 – 1000 seconds. The default is 30 seconds.

USING THE CLI

To change the RIP update interval, enter a command such as the following:

```
HP9300(config-rip-router)# update 120
```

This command configures the routing switch to send RIP updates every 120 seconds.

Syntax: update-time <1-1000>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Click on the General link to display the RIP configuration panel, shown in Figure 7.1 on page 7-10.
5. Enter a value from 1 – 1000 in the Update Time field.
6. Click the Apply button to save the change to the device's running-config file.
7. To configure settings for another port, select the port (and slot, if applicable) and go to step 5.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

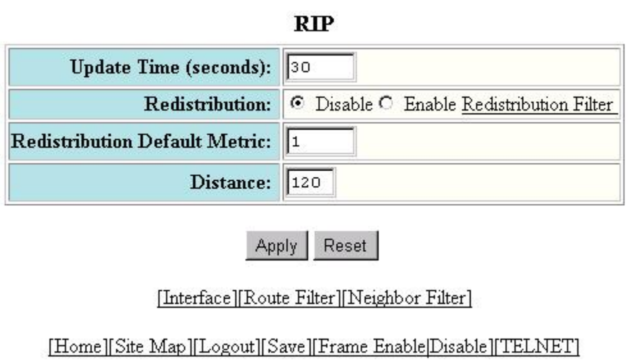


Figure 7.1 RIP configuration panel

Enabling Learning and Advertising of RIP Default Routes

By default, the routing switch does not learn or advertise RIP default routes. You can enable learning and advertising of RIP default routes on a global or interface basis.

USING THE CLI

To enable learning of default RIP routes on a global basis, enter the following command:

```
HP9300(config-rip-router)# learn-default
```

To enable learning of default RIP routes on an interface basis, enter commands such as the following:

```
HP9300(config)# interface ethernet 1/1
HP9300(config-if-1/1)# ip rip learn-default
```

Syntax: [no] learn-default

USING THE WEB MANAGEMENT INTERFACE

To enable learning of default RIP routes:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Click on the Interface link to display the RIP interface table.
5. Click on the Modify button in the row for the port.
6. Select Disable or Enable next to Learn Default.
7. Click the Apply button to save the change to the device's running-config file.

NOTE: To apply the changes to all RIP interfaces, select the Apply To All Ports button instead of the Apply button.

8. To configure settings for another port, select the port (and slot, if applicable) and go to step 5.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring a RIP Neighbor Filter

By default, an HP routing switch learns RIP routes from all its RIP neighbors. Neighbor filters allow you to specify the neighbor routers from which the HP routing switch can receive RIP routes. Neighbor filters apply globally to all ports.

USING THE CLI

To configure a RIP neighbor filters, enter a command such as the following:

```
HP9300(config-rip-router)# neighbor 1 deny any
```

Syntax: [no] neighbor <filter-num> permit | deny <source-ip-address> | any

This command configures the routing switch so that the device does not learn any RIP routes from any RIP neighbors.

The following commands configure the routing switch to learn routes from all neighbors except 192.168.1.170. Once you define a RIP neighbor filter, the default action changes from learning all routes from all neighbors to denying all routes from all neighbors except the ones you explicitly permit. Thus, to deny learning from a specific neighbor but allow all other neighbors, you must add a filter that allows learning from all neighbors. Make sure you add the filter to permit all neighbors as the last filter (the one with the highest filter number). Otherwise, the software can match on the permit all filter before a filter that denies a specific neighbor, and learn routes from that neighbor.

```
HP9300(config-rip-router)# neighbor 2 deny 192.16.1.170
HP9300(config-rip-router)# neighbor 1024 permit any
```

USING THE WEB MANAGEMENT INTERFACE

To define a RIP neighbor filter:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Click on the Neighbor Filter link.
   - If the device does not have any RIP neighbor filters, the RIP Neighbor Filter configuration panel is displayed, as shown in the following example.

- If a RIP neighbor filter is already configured and you are adding a new filter, click on the Add Neighbor Filter link to display the RIP Neighbor Filter configuration panel, as shown in the following example.
- If you are modifying an existing RIP neighbor filter, click on the Modify button to the right of the row describing the filter to display the RIP Neighbor Filter configuration panel, as shown in the following example.

5. Enter the filter ID.
6. Select either Permit or Deny as the action.
7. Enter the IP address of the RIP neighbor router.
8. Click the Add button to save the change to the device's running-config file.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

To modify or delete a RIP neighbor filter:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Click on the Neighbor Filter link.
5. Click the Modify or Delete button next to the filter that is to be changed or deleted. If you click Modify, enter the changes to the Action or IP Address fields and then click the Modify button apply the changes. If you click Delete, the filter is removed immediately.
6. Click the Add button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Changing the Route Loop Prevention Method

RIP can use the following methods to prevent routing loops:

- Split horizon – The routing switch does not advertise a route on the same interface as the one on which the routing switch learned the route. This is the default.
- Poison reverse – The routing switch assigns a cost of 16 ("infinite" or "unreachable") to a route before advertising it on the same interface as the one on which the routing switch learned the route.

These loop prevention methods are configurable on an individual interface basis.

NOTE: These methods are in addition to RIP's maximum valid route cost of 15.

USING THE CLI

To enable poison reverse on an interface, enter commands such as the following:

```
HP9300(config)# interface ethernet 1/1
HP9300(config-if-1/1)# ip rip poison-reverse
```

Syntax: [no] ip rip poison-reverse

USING THE WEB MANAGEMENT INTERFACE

To enable RIP routing on individual interfaces:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Click on the Interface link to display the RIP interface table.
5. Click on the Modify button in the row for the port.
6. Select poison reverse.
7. Click the Apply button to save the change to the device's running-config file.

NOTE: To apply the changes to all RIP interfaces, select the Apply To All Ports button instead of the Apply button.

8. To configure settings for another port, select the port (and slot, if applicable) and go to step 6.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Suppressing RIP Route Advertisement on a VRRP or VRRPE Backup Interface

NOTE: This section applies only if you configure the routing switch for Virtual Router Redundancy Protocol (VRRP) or VRRP Extended (VRRPE). See "Configuring VRRP and VRRPE" on page 12-1.

Normally, a VRRP or VRRPE Backup includes route information for the virtual IP address (the backed up interface) in RIP advertisements. As a result, other routers receive multiple paths for the backed up interface and might sometimes unsuccessfully use the path to the Backup rather than the path to the Master.

You can prevent the Backups from advertising route information for the backed up interface by enabling suppression of the advertisements.

USING THE CLI

To suppress RIP advertisements for the backed up interface in Router2, enter the following commands:

```
Router2(config)# router rip
Router2(config-rip-router)# use-vrrp-path
```

Syntax: [no] use-vrrp-path

The syntax is the same for VRRP and VRRPE.

USING THE WEB MANAGEMENT INTERFACE

See "Configuration Examples" on page 12-30.

Configuring RIP Route Filters

You can configure RIP route filters to permit or deny learning or advertising of specific routes. Configure the filters globally, then apply them to individual interfaces. When apply a RIP route filter to an interface, you specify whether the filter applies to learned routes (in) or advertised routes (out).

NOTE: A route is defined by the destination's IP address and network mask.

NOTE: Once you define a RIP route filter, the default action changes from learning and advertising all routes to denying all routes except the ones you explicitly permit. Thus, to deny specific routes but allow all other routes, you must add a filter that allows all other routes. When you apply route filters to an interface, make sure you apply the one that allows all routes as the last filter. Otherwise, the software can match on the permit all filter before a filter that denies a specific route, and permit a route you intended to deny.

USING THE CLI

To configure RIP filters, enter commands such as the following:

```
HP9300(config-rip-router)# filter 1 permit 192.53.4.1 255.255.255.0
HP9300(config-rip-router)# filter 2 permit 192.53.5.1 255.255.255.0
HP9300(config-rip-router)# filter 3 permit 192.53.6.1 255.255.255.0
HP9300(config-rip-router)# filter 4 deny 192.53.7.1 255.255.255.0
```

These commands explicitly permit RIP routes to three networks, and deny the route to one network.

Since the default action changes from permit to deny once you configure and apply a RIP filter, no other routes can be learned or advertised on the interfaces to which you apply these filters.

Syntax: filter <filter-num> permit | deny <source-ip-address> | any <source-mask> | any [log]

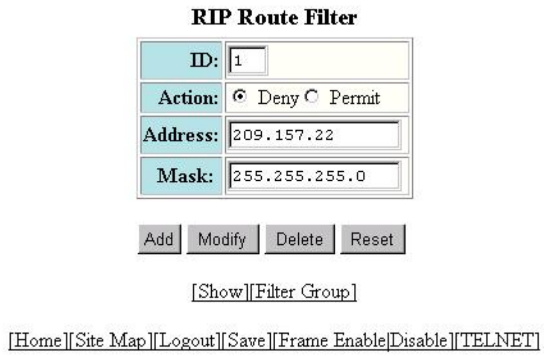
The following commands deny a specific route and permit all other routes:

```
HP9300(config-rip-router)# filter 5 deny 192.168.1.170 255.255.255.0
HP9300(config-rip-router)# filter 1024 permit any any
```

USING THE WEB MANAGEMENT INTERFACE

To define a RIP route filter:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Click on the Route Filter link.
    - If the device does not have any RIP route filters, the RIP Route Filter configuration panel is displayed, as shown in the following example.
    - If a RIP route filter is already configured and you are adding a new filter, click on the Add Route Filter link to display the RIP Route Filter configuration panel, as shown in the following example.
    - If you are modifying an existing RIP route filter, click on the Modify button to the right of the row describing the filter to display the RIP Route Filter configuration panel, as shown in the following example.



5. Enter the filter ID.
6. Select either Permit or Deny as the action.
7. Enter an IP address and mask or the wildcard value, 0.0.0.0, to allow all routes.
8. Click the Add button to save the change to the device's running-config file.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

To modify or delete a RIP route filter:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Select the Route Filter link.
5. Click on the Modify button or Delete button to the right of the row describing the filter.
6. If you are modifying a filter, see the procedure above for configuration information.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Applying a RIP Route Filter to an Interface

Once you define RIP route filters, you must assign them to individual interfaces. The filters do not take effect until you apply them to interfaces. When you apply a RIP route filter, you also specify whether the filter applies to learned routes or advertised routes:

- Out filters apply to routes the routing switch advertises to its neighbor on the interface.
- In filters apply to routes the routing switch learns from its neighbor on the interface.

USING THE CLI

To apply RIP route filters to an interface, enter commands such as the following:

```
HP9300(config)# interface ethernet 1/2
HP9300(config-if-1/2)# ip rip filter-group in 2 3 4
```

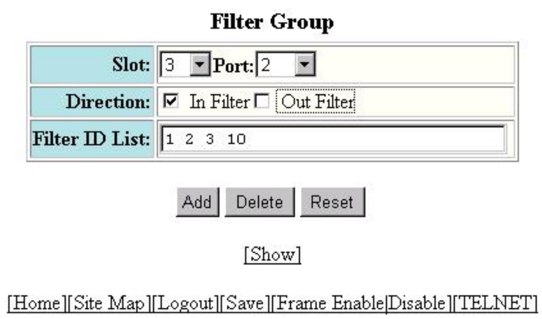
Syntax: [no] ip rip filter-group in | out <filter-list>

These commands apply RIP route filters 2, 3, and 4 to all routes learned from the RIP neighbor on port 1/2.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.

2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to RIP in the tree view to expand the list of RIP option links.
4. Select the Route Filter link.
5. Select the Filter Group link.
   - If the device does not have any RIP filter groups, the Filter Group configuration panel is displayed, as shown in the following example.
   - If a RIP filter group is already configured and you are adding a new group, click on the Add RIP Route Filter Group link to display the Filter Group configuration panel, as shown in the following example.
   - If you are modifying an existing RIP filter group, click on the Modify button to the right of the row describing the group to display the Filter Group configuration panel, as shown in the following example.



6. Select the port (and slot if applicable) to which you are assigning the filter.
7. Select either or both the In Filter and Out Filter options.
   - Selecting In Filter applies the filters to all RIP updates received on the port.
   - Selecting Out Filter applies the filters to all routes advertised on the port.
   - Selecting both options applies the filters to both incoming updates and outgoing advertisements.
8. Click the Add button to save the change to the device's running-config file.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Displaying RIP Filters

To display the RIP filters configured on the routing switch, use one of the following methods.

USING THE CLI

To display RIP filters, enter the following command at any CLI level:

```
HP9300> show ip rip

                RIP Route Filter Table
  Index   Action   Route IP Address    Subnet Mask
  1       deny     any                 any
                RIP Neighbor Filter Table
  Index   Action   Neighbor IP Address
  1       permit   any
```

Syntax: show ip rip

This display shows the following information.

Table 7.3: CLI Display of RIP Filter Information

This Field...	Displays...
Route filters The rows underneath "RIP Route Filter Table" list the RIP route filters. If no RIP route filters are configured on the device, the following message is displayed instead: "No Filters are configured in RIP Route Filter Table".	
Index	The filter number. You assign this number when you configure the filter.
Action	The action the router takes if a RIP route packet matches the IP address and sub-net mask of the filter. The action can be one of the following: • deny – RIP route packets that match the address and network mask information in the filter are dropped. If applied to an interface's outbound filter group, the filter prevents the router from advertising the route on that interface. If applied to an interface's inbound filter group, the filter prevents the router from adding the route to its IP route table. • permit – RIP route packets that match the address and network mask information are accepted. If applied to an interface's outbound filter group, the filter allows the router to advertise the route on that interface. If applied to an interface's inbound filter group, the filter allows the router to add the route to its IP route table.
Route IP Address	The IP address of the route's destination network or host.
Subnet Mask	The network mask for the IP address.
Neighbor filters The rows underneath "RIP Neighbor Filter Table" list the RIP neighbor filters. If no RIP neighbor filters are configured on the device, the following message is displayed instead: "No Filters are configured in RIP Neighbor Filter Table".	
Index	The filter number. You assign this number when you configure the filter.
Action	The action the router takes for RIP route packets to or from the specified neighbor: • deny – If the filter is applied to an interface's outbound filter group, the filter prevents the router from advertising RIP routes to the specified neighbor on that interface. If the filter is applied to an interface's inbound filter group, the filter prevents the router from receiving RIP updates from the specified neighbor. • permit – If the filter is applied to an interface's outbound filter group, the filter allows the router to advertise RIP routes to the specified neighbor on that interface. If the filter is applied to an interface's inbound filter group, the filter allows the router to receive RIP updates from the specified neighbor.
Neighbor IP Address	The IP address of the RIP neighbor.

USING THE WEB MANAGEMENT INTERFACE

To display RIP filter information:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view.
3. Click on the plus sign next to RIP.
4. Select one of the following links:
   - Neighbor Filter
   - Route Filter
   - Redistribution Filter

Chapter 8
Configuring OSPF

This chapter describes how to configure OSPF on HP routing switches using the CLI and Web management interface.

To display OSPF configuration information and statistics, see “Displaying OSPF Information” on page 8-39.

For complete syntax information for the CLI commands shown in this chapter, see the *Command Line Interface Reference*.

NOTE: The HP 6308M-SX routing switches and Chassis routing switches using basic management modules (modules that do not use H2R flash code) can contain 10000 routes by default. If you need to increase the capacity of the IP route table for OSPF, see the “Displaying and Modifying System Parameter Default Settings“ section in the “Configuring Basic Features“ chapter of the *Installation and Getting Started Guide*.

Overview of OSPF

OSPF is a link-state routing protocol. The protocol uses link-state advertisements (LSA) to update neighboring routers regarding its interfaces and information on those interfaces. The routing switch floods these LSAs to all neighboring routers to update them regarding the interfaces. Each router maintains an identical database that describes its area topology to help a router determine the shortest path between it and any neighboring router.

HP routing switches support the following types of LSAs, which are described in RFC 1583:

- Router link
- Network link
- Summary link
- Autonomous system (AS) summary link
- AS external link
- NSSA external link

OSPF is built upon a hierarchy of network components. The highest level of the hierarchy is the ***Autonomous System (AS)***. An autonomous system is defined as a number of networks, all of which share the same routing and administration characteristics.

An AS can be divided into multiple ***areas*** as shown in Figure 8.1 on page 8-2. Each area represents a collection of contiguous networks and hosts. Areas limit the area to which link-state advertisements are broadcast, thereby limiting the amount of flooding that occurs within the network. An area is represented in OSPF by either an IP address or a number.

You can further limit the broadcast area of flooding by defining an area range. The area range allows you to assign an aggregate value to a range of IP addresses. This aggregate value becomes the address that is advertised instead all of the individual addresses it represents being advertised. You can assign up to 32 ranges in an OSPF area.

An OSPF router can be a member of multiple areas. Routers with membership in multiple areas are known as ***Area Border Routers (ABRs)***. Each ABR maintains a separate topological database for each area the router is in. Each topological database contains all of the LSA databases for each router within a given area. The routers within the same area have identical topological databases. The ABR is responsible for forwarding routing information or changes between its border areas.

An ***Autonomous System Boundary Router (ASBR)*** is a router that is running multiple protocols and serves as a gateway to routers outside an area and those operating with different protocols. The ASBR is able to import and translate different protocol routes into OSPF through a process known as ***redistribution***. For more details on redistribution and configuration examples, see “Enable Route Redistribution” on page 8-28.

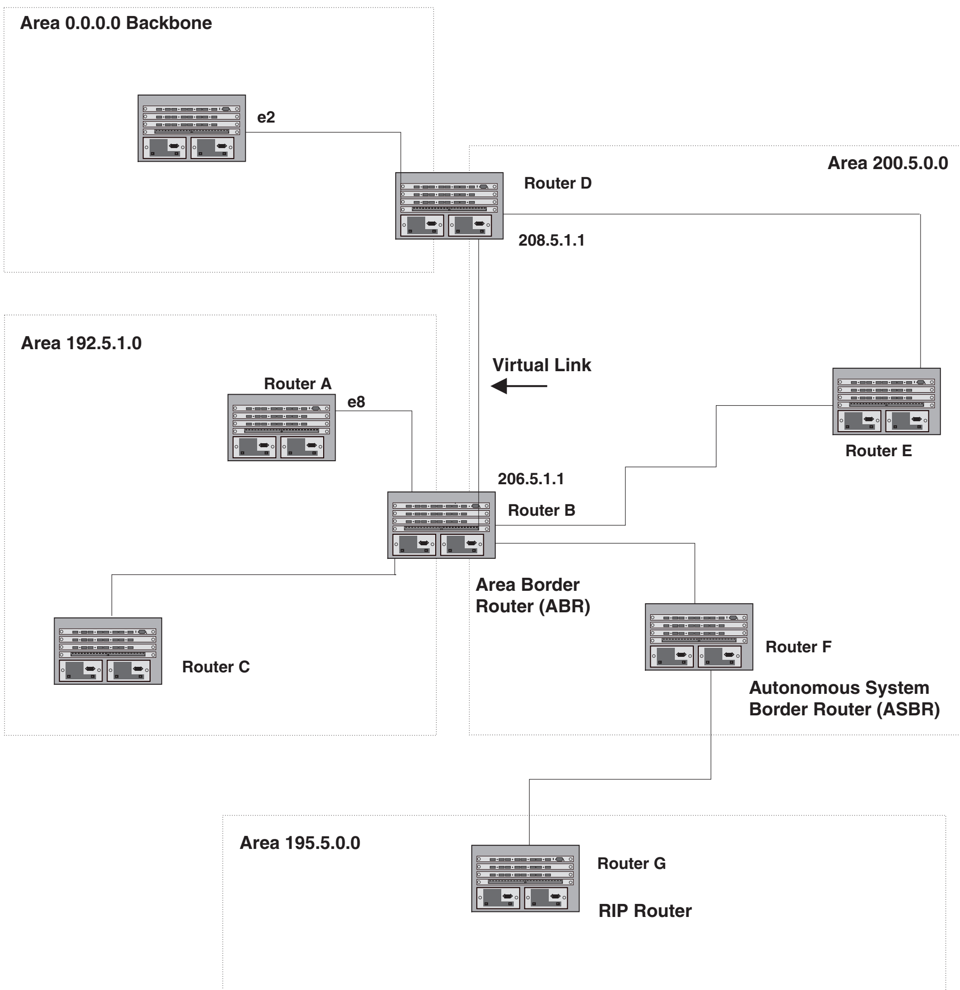


Figure 8.1 OSPF operating in a network

Designated Routers in Multi-Access Networks

In a network that has multiple routers attached, OSPF elects one router to serve as the designated router (DR) and another router on the segment to act as the backup designated router (BDR). This arrangement minimizes the amount of repetitive information that is forwarded on the network by forwarding all messages to the designated router and backup designated routers responsible for forwarding the updates throughout the network.

Designated Router Election

In a network with no designated router and no backup designated router, the neighboring router with the highest priority is elected as the DR, and the router with the next largest priority is elected as the BDR, as shown in Figure 8.2

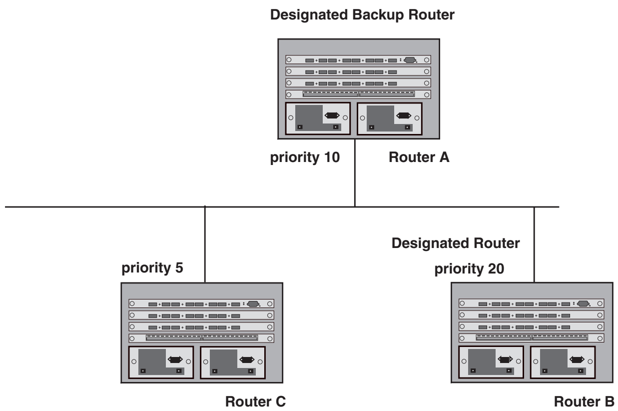


Figure 8.2 Designated and backup router election

If the DR goes off-line, the BDR automatically becomes the DR. The router with the next highest priority becomes the new BDR. This process is shown in Figure 8.3.

NOTE: Priority is a configurable option at the interface level. You can use this parameter to help bias one routing switch as the DR.

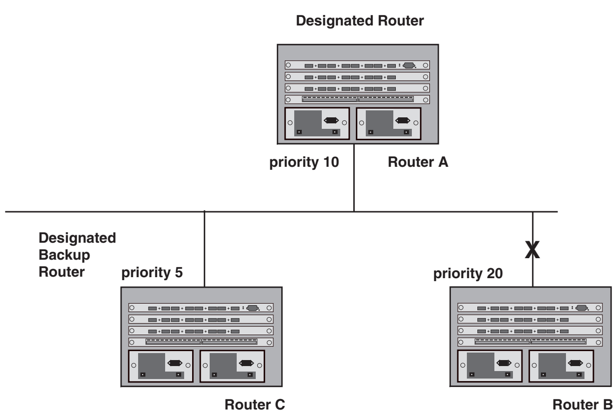


Figure 8.3 Backup designated router becomes designated router

If two neighbors share the same priority, the router with the highest router ID is designated as the DR. The router with the next highest router ID is designated as the BDR.

NOTE: By default, the HP router ID is the IP address configured on the lowest numbered loopback interface. If the routing switch does not have a loopback interface, the default router ID is the lowest numbered IP address configured on the device. For more information or to change the router ID, see “Changing the Router ID” on page 6-25.

When multiple routing switches on the same network are declaring themselves as DRs, then both priority and router ID are used to select the designated router and backup designated routers.

When only one router on the network claims the DR role despite neighboring routers with higher priorities or router IDs, this router remains the DR. This is also true for BDRs.

The DR and BDR election process is performed when one of the following events occurs:

- an interface is in a waiting state and the wait time expires
- an interface is in a waiting state and a hello packet is received that addresses the BDR
- a change in the neighbor state occurs, such as:
  - a neighbor state transitions from 2 or higher
  - communication to a neighbor is lost
  - a neighbor declares itself to be the DR or BDR for the first time

OSPF RFC 1583 and 2178 Compliance

HP routing switches are configured, by default, to be compliant with the RFC 1583 OSPF V2 specification. HP routing switches can also be configured to operate with the latest OSPF standard, RFC 2178.

NOTE: For details on how to configure the system to operate with the RFC 2178, see “Configuring OSPF” on page 8-7.

Reduction of Equivalent AS External LSAs

An OSPF ASBR uses AS External link advertisements (AS External LSAs) to originate advertisements of a route to another routing domain, such as a BGP4 or RIP domain. The ASBR advertises the route to the external domain by flooding AS External LSAs to all the other OSPF routers (except those inside stub networks) within the local OSPF Autonomous System (AS).

In some cases, multiple ASBRs in an AS can originate equivalent LSAs. The LSAs are equivalent when they have the same cost, the same next hop, and the same destination. Software release 07.1.*X* and later optimize OSPF by eliminating duplicate AS External LSAs in this case. The routing switch with the lower router ID flushes the duplicate External LSAs from its database and thus does not flood the duplicate External LSAs into the OSPF AS. AS External LSA reduction therefore reduces the size of the routing switch’s link state database.

This enhancement implements the portion of RFC 2328 that describes AS External LSA reduction. This enhancement is enabled by default, requires no configuration, and cannot be disabled.

Figure 8.4 shows an example of the AS External LSA reduction feature. In this example, HP routing switches D and E are OSPF ASBRs, and thus communicate route information between the OSPF AS, which contains Routers A, B, and C, and another routing domain, which contains Router F. The other routing domain is running another routing protocol, such as BGP4 or RIP. Routers D, E, and F, therefore, are each running both OSPF and either BGP4 or RIP.

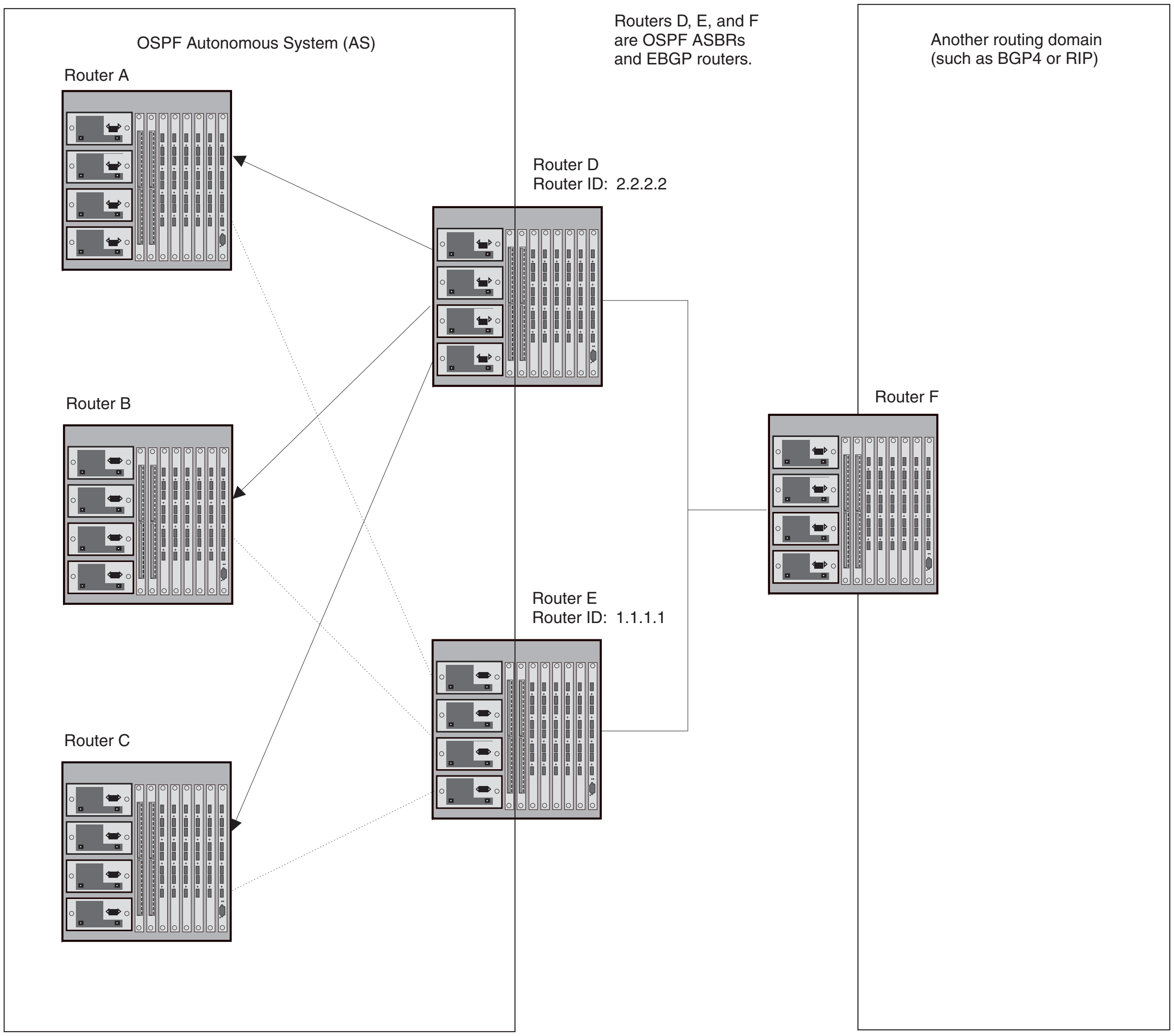


Figure 8.4 AS External LSA reduction

Notice that both Router D and Router E have a route to the other routing domain through Router F. In software releases earlier than 07.1.*X*, if Routers D and E have equal-cost routes to Router F, then both Router D and Router E flood AS External LSAs to Routers A, B, and C advertising the route to Router F. Since both routers are flooding equivalent routes, Routers A, B, and C receive multiple routes with the same cost to the same destination (Router F). For Routers A, B, and C, either route to Router F (through Router D or through Router E) is equally good.

OSPF eliminates the duplicate AS External LSAs. When two or more HP routing switches configured as ASBRs have equal-cost routes to the same next-hop router in an external routing domain, the ASBR with the highest router ID floods the AS External LSAs for the external domain into the OSPF AS, while the other ASBRs flush the equivalent AS External LSAs from their databases. As a result, the overall volume of route advertisement traffic within the AS is reduced and the routing switches that flush the duplicate AS External LSAs have more memory for other OSPF data. In Figure 8.4, since Router D has a higher router ID than Router E, Router D floods the AS External LSAs for Router F to Routers A, B, and C. Router E flushes the equivalent AS External LSAs from its database.

Algorithm for AS External LSA Reduction

Figure 8.4 shows an example in which the normal AS External LSA reduction feature is in effect. The behavior changes under the following conditions:

- There is one ASBR advertising (originating) a route to the external destination, but one of the following happens:
  - A second ASBR comes on-line
  - A second ASBR that is already on-line begins advertising an equivalent route to the same destination.

  In either case above, the routing switch with the higher router ID floods the AS External LSAs and the other routing switch flushes its equivalent AS External LSAs. For example, if Router D is offline, Router E is the only source for a route to the external routing domain. When Router D comes on-line, it takes over flooding of the AS External LSAs to Router F, while Router E flushes its equivalent AS External LSAs to Router F.
- One of the ASBRs starts advertising a route that is no longer equivalent to the route the other ASBR is advertising. In this case, the ASBRs each flood AS External LSAs. Since the LSAs either no longer have the same cost or no longer have the same next-hop router, the LSAs are no longer equivalent, and the LSA reduction feature no longer applies.
- The ASBR with the higher router ID becomes unavailable or is reconfigured so that it is no longer an ASBR. In this case, the other ASBR floods the AS External LSAs. For example, if Router D goes off-line, then Router E starts flooding the AS with AS External LSAs for the route to Router F.

Dynamic OSPF Activation and Configuration

OSPF is automatically activated when you enable it. The protocol does not require a software reload.

You can configure and save the following OSPF changes without resetting the system:

- all OSPF interface-related parameters (for example: area, hello timer, router dead time cost, priority, re-transmission time, transit delay)
- all area parameters
- all area range parameters
- all virtual-link parameters
- all global parameters
- creation and deletion of an area, interface or virtual link

In addition, you can make the following changes without a system reset by first disabling and then re-enabling OSPF operation:

- changes to address ranges
- changes to global values for redistribution
- addition of new virtual links

You also can change the amount of memory allocated to various types of LSA entries. However, these changes require a system reset or reboot.

Dynamic OSPF Memory

Software release 07.1.*X* and later dynamically allocate memory for Link State Advertisements (LSAs) and other OSPF data structures.

In previous software releases, OSPF memory is statically allocated. If the routing switch runs out of memory for a given LSA type in releases earlier than 07.1.*X*, an overflow condition occurs and the software sends a message to the Syslog. To change memory allocation requires entering CLI commands and reloading the software.

Software release 07.1.*X* and later eliminate the overflow conditions and do not require a reload to change OSPF memory allocation. So long as the routing switch has free (unallocated) dynamic memory, OSPF can use the memory.

Since dynamic memory allocation is automatic and requires no configuration, the following CLI commands and equivalent Web management options are not supported in software release 07.1.*X*:

- **maximum-number-of-lsa external** <num>
- **maximum-number-of-lsa router** <num>
- **maximum-number-of-lsa network** <num>
- **maximum-number-of-lsa summary** <num>
- **max-routes** <num>

If you boot a device that has a startup-config file that contains these commands, the software ignores the commands and uses dynamic memory allocation for OSPF. The first time you save the device's running configuration (running-config) to the startup-config file, the commands are removed from the file.

NOTE: The **external-lsdb-overflow** command is still supported in accordance with RFC 1765.

To display the current allocations of dynamic memory, enter the show memory command. See the *Command Line Interface Reference*.

Configuring OSPF

To begin using OSPF on the routing switch, perform the steps outlined below:

1. Enable OSPF on the routing switch.
2. Assign the areas to which the routing switch will be attached.
3. Assign individual interfaces to the OSPF areas.
4. Define redistribution filters, if desired.
5. Enable redistribution, if you defined redistribution filters.
6. Modify default global and port parameters as required.
7. Modify OSPF standard compliance, if desired.

NOTE: OSPF is automatically enabled without a system reset.

Configuration Rules

- If a routing switch is to operate as an ASBR, you must enable the ASBR capability at the system level.
- Redistribution must be enabled on routing switches configured to operate as ASBRs.
- All routing switch ports must be assigned to one of the defined areas on an OSPF routing switch. When a port is assigned to an area, all corresponding sub-nets on that port are automatically included in the assignment.

OSPF Parameters

You can modify or set the following global and interface OSPF parameters.

Global Parameters

- Modify OSPF standard compliance setting.
- Assign an area.
- Define an area range.
- Define the area virtual link.
- Set global default metric for OSPF.

- Disable or re-enable load sharing.
- Enable or disable default-information-originate.
- Modify Shortest Path First (SPF) timers
- Define external route summarization
- Define redistribution metric type.
- Define deny redistribution.
- Define permit redistribution.
- Enable redistribution.
- Change the LSA pacing interval.
- Modify OSPF Traps generated.
- Modify database overflow interval.

Interface Parameters

- Assign interfaces to an area.
- Define the authentication key for the interface.
- Modify the cost for a link.
- Modify the dead interval.
- Modify MD5 authentication key parameters.
- Modify the priority of the interface.
- Modify the retransmit interval for the interface.
- Modify the transit delay of the interface.

NOTE: When using CLI, you set global level parameters at the OSPF CONFIG Level of the CLI. To reach that level, enter **router ospf…** at the global CONFIG Level. Interface parameters for OSPF are set at the interface CONFIG Level using the CLI command, **ip ospf…**

When using the Web management interface, you set OSPF global parameters using the OSPF configuration panel. All other parameters are accessed through links accessed from the OSPF configuration sheet.

Enable OSPF on the Routing Switch

When you enable OSPF on the routing switch, the protocol is automatically activated. To enable OSPF on the routing switch, use one of the following methods:

USING THE CLI

```
HP9300(config)# router ospf
```

This command launches you into the OSPF router level where you can assign areas and modify OSPF global parameters.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Select Enable next to OSPF.
3. Click the Apply button to save the change to the device's running-config file.
4. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Note Regarding Disabling OSPF

If you disable OSPF, the routing switch removes all the configuration information for the disabled protocol from the running-config. Moreover, when you save the configuration to the startup-config file after disabling one of these protocols, all the configuration information for the disabled protocol is removed from the startup-config file.

The CLI displays a warning message such as the following:

```
HP9300(config-ospf-router)# no router ospf
router ospf mode now disabled. All ospf config data will be lost when writing to
flash!
```

The Web management interface does not display a warning message.

If you have disabled the protocol but have not yet saved the configuration to the startup-config file and reloaded the software, you can restore the configuration information by re-entering the command to enable the protocol (ex: **router ospf**), or by selecting the Web management option to enable the protocol. If you have already saved the configuration to the startup-config file and reloaded the software, the information is gone.

If you are testing an OSPF configuration and are likely to disable and re-enable the protocol, you might want to make a backup copy of the startup-config file containing the protocol's configuration information. This way, if you remove the configuration information by saving the configuration after disabling the protocol, you can restore the configuration by copying the backup copy of the startup-config file onto the flash memory.

Assign OSPF Areas

Once OSPF is enabled on the system, you can assign areas. Assign an IP address or number as the ***area ID*** for each area. The area ID is representative of all IP addresses (sub-nets) on a routing switch port. Each port on a routing switch can support one area.

An area can be ***normal***, a ***stub***, or a ***Not-So-Stubby Area (NSSA)***.

- Normal – OSPF routing switches within a normal area can send and receive External Link State Advertisements (LSAs).
- Stub – OSPF routing switches within a stub area cannot send or receive External LSAs. In addition, OSPF routing switches in a stub area must use a default route to the area's Area Border Router (ABR) or Autonomous System Boundary Router (ASBR) to send traffic out of the area.
- NSSA – The ASBR of an NSSA can import external route information into the area.
  - ASBRs redistribute (import) external routes into the NSSA as type 7 LSAs. Type-7 External LSAs are a special type of LSA generated only by ASBRs within an NSSA, and are flooded to all the routing switches within only that NSSA.
  - ABRs translate type 7 LSAs into type 5 External LSAs, which can then be flooded throughout the AS. You can configure address ranges on the ABR of an NSSA so that the ABR converts multiple type-7 External LSAs received from the NSSA into a single type-5 External LSA.

    When an NSSA contains more than one ABR, OSPF elects one of the ABRs to perform the LSA translation for NSSA. OSPF elects the ABR with the highest router ID. If the elected ABR becomes unavailable, OSPF automatically elects the ABR with the next highest router ID to take over translation of LSAs for the NSSA. The election process for NSSA ABRs is automatic.

EXAMPLE:

To set up the OSPF areas shown in Figure 8.1 on page 8-2, use one of the following methods.

USING THE CLI

```
HP9300(config-ospf-router)# area 192.5.1.0
HP9300(config-ospf-router)# area 200.5.0.0
HP9300(config-ospf-router)# area 195.5.0.0
HP9300(config-ospf-router)# area 0.0.0.0
HP9300(config-ospf-router) write memory
```

Syntax: area <num> | <ip-addr> [nssa <cost> | stub <cost> [no-summary]]

The <num> | <ip-addr> parameter specifies the area number, which can be a number or in IP address format. If you specify an number, the number can be from 0 – 2,147,483,647.

The **nssa** parameter specifies that this is an NSSA. For more information about configuring NSSAs, see “Assign a Not-So-Stubby Area (NSSA)” on page 8-11.

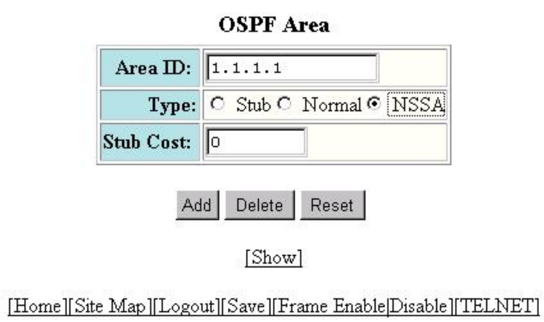
The <cost> specifies an additional cost for using a route to or from this area and can be from 1 – 16777215. If you configure a stub area or NSSA, you must specify the cost. There is no default. Normal areas do not use the cost parameter.

The **no-summary** parameter applies only to stub areas and disables summary LSAs from being sent into the area. See “Assign a Totally Stubby Area” on page 8-11.

NOTE: You can assign one area on a routing switch interface. For example, if the system or chassis module has 16 ports, 16 areas are supported on the chassis or module.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled OSPF, enable it by clicking on the Enable radio button next to OSPF on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
5. Click on the Area link to display the OSPF Area configuration panel, as shown in the following figure.



NOTE: If the device already has OSPF areas, a table listing the areas is displayed. Click the Modify button to the right of the row describing an area to change its configuration, or click the Add Area link to display the OSPF Area configuration panel.

---

6. Enter the area ID in the Area ID field. The ID can be a number or an IP address.
7. Select the area type by clicking on the radio button next to its description in the Type field. For example, to select NSSA, click next to NSSA.
8. If you are configuring a stub area or NSSA, enter a cost in the Stub Cost field. The parameter is required for those area types but is not required for normal areas. You can specify from 1 – 16777215. There is no default.
9. Click the Add button to add the area to the running-config file.
10. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Assign a Totally Stubby Area

By default, the routing switch sends summary LSAs (LSA type 3) into stub areas. You can further reduce the number of link state advertisements (LSA) sent into a stub area by configuring the routing switch to stop sending summary LSAs (type 3 LSAs) into the area. You can disable the summary LSAs when you are configuring the stub area or later after you have configured the area.

This feature disables origination of summary LSAs, but the routing switch still accepts summary LSAs from OSPF neighbors and floods them to other neighbors. The routing switch can form adjacencies with other routers regardless of whether summarization is enabled or disabled for areas on each routing switch.

When you enter a command or apply a Web management option to disable the summary LSAs, the change takes effect immediately. If you apply the option to a previously configured area, the routing switch flushes all of the summary LSAs it has generated (as an ABR) from the area.

NOTE: This feature applies only when the routing switch is configured as an Area Border Router (ABR) for the area. To completely prevent summary LSAs from being sent to the area, disable the summary LSAs on each OSPF router that is an ABR for the area.

This feature does not apply to Not So Stubby Areas (NSSAs).

To disable summary LSAs for a stub area, use the following CLI method.

USING THE CLI

To disable summary LSAs for a stub area, enter commands such as the following:

```
HP9300(config-ospf-router)# area 40 stub no-summary
```

Syntax: area <num> | <ip-addr> [nssa <cost> | stub <cost> [no-summary]]

The <num> | <ip-addr> parameter specifies the area number, which can be a number or in IP address format. If you specify an number, the number can be from 0 – 2,147,483,647.

The **nssa** parameter specifies that this is an NSSA. For more information about configuring NSSAs, see “Assign a Not-So-Stubby Area (NSSA)” on page 8-11.

The <cost> specifies an additional cost for using a route to or from this area and can be from 1 – 16777215. If you configure a stub area or NSSA, you must specify the cost. There is no default. Normal areas do not use the cost parameter.

The **no-summary** parameter applies only to stub areas and disables summary LSAs from being sent into the area.

NOTE: You can assign one area on a routing switch interface. For example, if the system or chassis module has 16 ports, 16 areas are supported on the chassis or module.

USING THE WEB MANAGEMENT INTERFACE

You can configure a stubby area using the Web management interface, but you cannot disable summary LSAs for the area. You must use the CLI to disable the summary LSAs.

Assign a Not-So-Stubby Area (NSSA)

The OSPF Not So Stubby Area (NSSA) feature enables you to configure OSPF areas that provide the benefits of stub areas, but that also are capable of importing external route information. OSPF does not flood external routes from other areas into an NSSA, but does translate and flood route information from the NSSA into other areas such as the backbone.

NSSAs are especially useful when you want to summarize Type-5 External LSAs (external routes) before forwarding them into an OSPF area. The OSPF specification (RFC 2328) prohibits summarization of Type-5 LSAs and requires OSPF to flood Type-5 LSAs throughout a routing domain. When you configure an NSSA, you can specify an address range for aggregating the external routes that the NSSA's ABR exports into other areas.

The HP implementation of NSSA is based on RFC 1587.

Figure 8.5 shows an example of an OSPF network containing an NSSA.

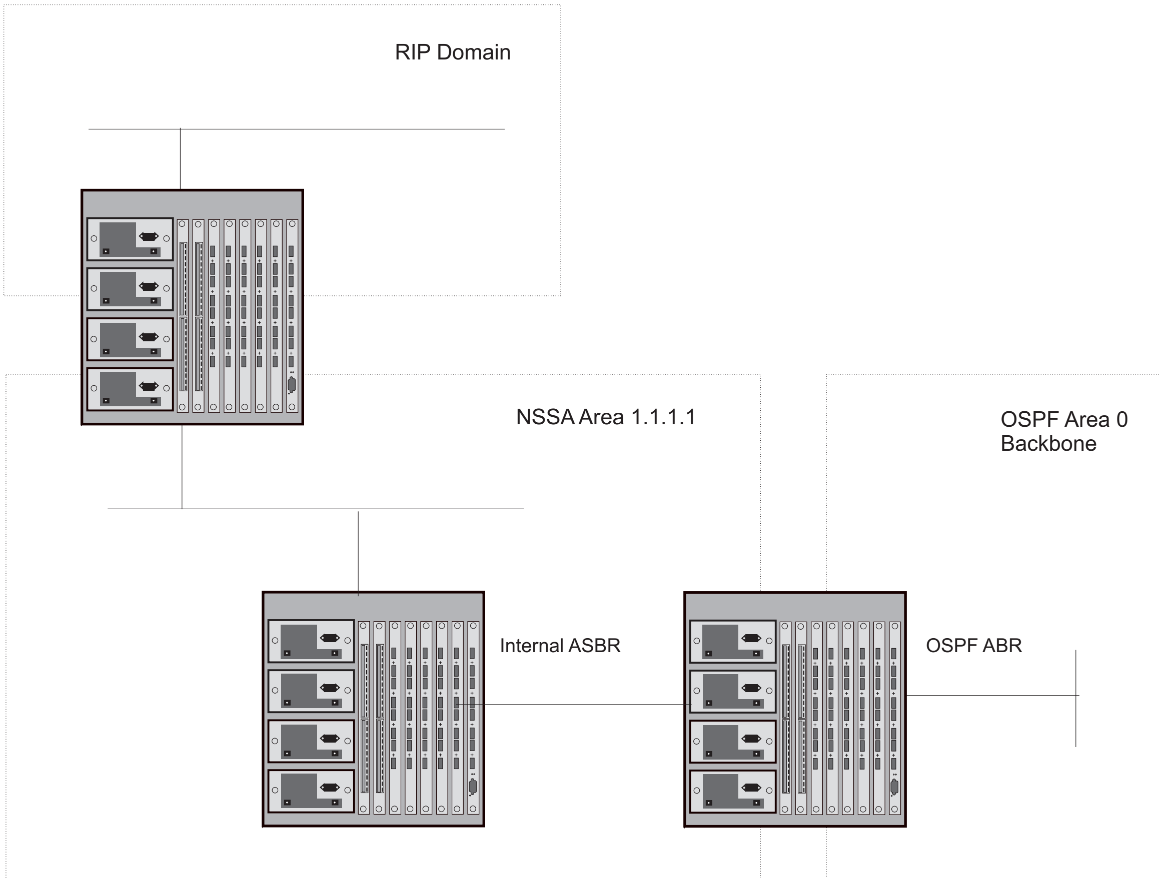


Figure 8.5 OSPF network containing an NSSA

This example shows two routing domains, a RIP domain and an OSPF domain. The ASBR inside the NSSA imports external routes from RIP into the NSSA as Type-7 LSAs, which the ASBR floods throughout the NSSA.

The ABR translates the Type-7 LSAs into Type-5 LSAs. If an area range is configured for the NSSA, the ABR also summarizes the LSAs into an aggregate LSA before flooding the Type-5 LSA(s) into the backbone.

Since the NSSA is partially “stubby” the ABR does not flood external LSAs from the backbone into the NSSA. To provide access to the rest of the Autonomous System (AS), the ABR generates a default Type-7 LSA into the NSSA.

Configuring an NSSA

To configure an NSSA, use one of the following methods.

USING THE CLI

To configure OSPF area 1.1.1.1 as an NSSA, enter the following commands.

```
HP9300(config)# router ospf
HP9300(config-ospf-router)# area 1.1.1.1 nssa 1
HP9300(config-ospf-router)# write memory
```

Syntax: area <num> | <ip-addr> [nssa <cost> | stub <cost> [no-summary]]

The <num> | <ip-addr> parameter specifies the area number, which can be a number or in IP address format. If you specify an number, the number can be from 0 – 2,147,483,647.

The **nssa** parameter specifies that this is an NSSA. For more information about configuring NSSAs, see “Assign a Not-So-Stubby Area (NSSA)” on page 8-11.

The <cost> specifies an additional cost for using a route to or from this area and can be from 1 – 16777215. If you configure a stub area or NSSA, you must specify the cost. There is no default. Normal areas do not use the cost parameter.

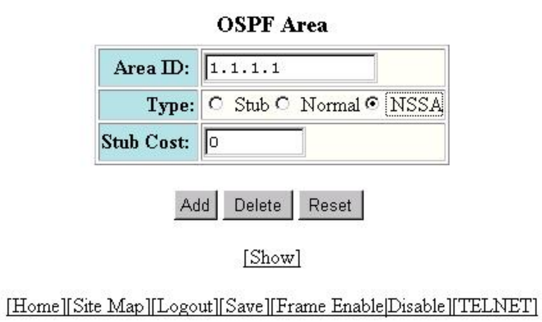
The **no-summary** parameter applies only to stub areas and disables summary LSAs from being sent into the area. See “Assign a Totally Stubby Area” on page 8-11.

NOTE: You can assign one area on a routing switch interface. For example, if the system or chassis module has 16 ports, 16 areas are supported on the chassis or module.

To configure additional parameters for OSPF interfaces in the NSSA, use the **ip ospf area…** command at the interface level of the CLI.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled OSPF, enable it by clicking on the Enable radio button next to OSPF on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
5. Click on the Area link to display the OSPF Area configuration panel, as shown in the following figure.



NOTE: If the device already has OSPF areas, a table listing the areas is displayed. Click the Modify button to the right of the row describing an area to change its configuration, or click the Add Area link to display the OSPF Area configuration panel.

---

6. Enter the area ID in the Area ID field. The ID can be a number or an IP address.
7. Select NSSA by clicking on the radio button next to NSSA in the Type field.
8. Enter a cost in the Stub Cost field. This parameter is required. You can specify from 1 – 16777215. There is no default.
9. Click the Add button to add the area.
10. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Configuring an Address Range for the NSSA

If you want the ABR that connects the NSSA to other areas to summarize the routes in the NSSA before translating them into Type-5 LSAs and flooding them into the other areas, configure an address range. The ABR creates an aggregate value based on the address range. The aggregate value becomes the address that the ABR advertises instead of advertising the individual addresses represented by the aggregate. You can configure up to 32 ranges in an OSPF area.

USING THE CLI

To configure an address range in NSSA 1.1.1.1, enter the following commands. This example assumes that you have already configured NSSA 1.1.1.1.

```
HP9300(config)# router ospf
HP9300(config-ospf-router)# area 1.1.1.1 range 209.157.22.1 255.255.0.0
HP9300(config-ospf-router)# write memory
```

Syntax: area <num> | <ip-addr> range <ip-addr> <ip-mask>

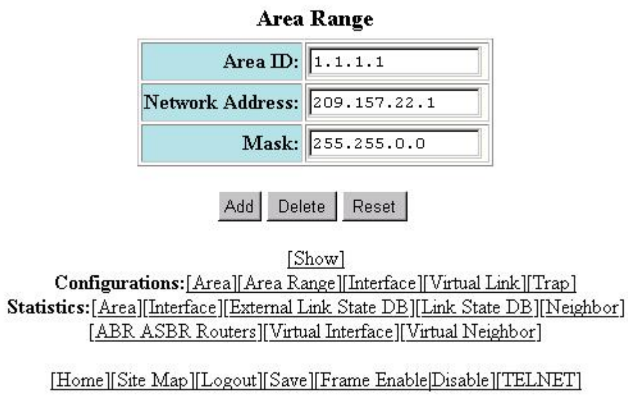
The <num> | <ip-addr> parameter specifies the area number, which can be in IP address format.

The <ip-addr> parameter following **range** specifies the IP address portion of the range. The software compares the address with the significant bits in the mask. All network addresses that match this comparison are summarized in a single route advertised by the routing switch.

The <ip-mask> parameter specifies the portions of the IP address that a route must contain to be summarized in the summary route. In the example above, all networks that begin with 209.157 are summarized into a single route.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled OSPF, enable it by clicking on the Enable radio button next to OSPF on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
5. Click on the Area Range link to display the OSPF Area Range configuration panel.
6. Click on the Add Area Range link to display the following panel.



NOTE: If the device already has an OSPF area range, a table listing the ranges is displayed. Click the Modify button to the right of the row describing a range to change its configuration, or click the Add Area Range link to display the OSPF Area Range configuration panel.

7. Enter the area ID in the Area ID field.
8. Enter an IP address in the Network Address field.
9. Enter a network mask in the Mask field. The software compares the address with the significant bits in the mask. All network addresses that match this comparison are summarized in a single route advertised by the routing switch.
10. Click the Add button to add the area.
11. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Assigning an Area Range (optional)

You can assign a ***range*** for an area, but it is not required. Ranges allow a specific IP address and mask to represent a range of IP addresses within an area, so that only that reference range address is advertised to the network, instead of all the addresses within that range. Each area can have up to 32 range addresses.

USING THE CLI

EXAMPLE:

To define an area range for sub-nets on 193.45.5.1 and 193.45.6.2, enter the following command:

```
HP9300(config)# router ospf
HP9300(config-ospf-router)# area 192.45.5.1 range 193.45.0.0 255.255.0.0
HP9300(config-ospf-router)# area 193.45.6.2 range 193.45.0.0 255.255.0.0
```

The <num> | <ip-addr> parameter specifies the area number, which can be in IP address format.

The <ip-addr> parameter following **range** specifies the IP address portion of the range. The software compares the address with the significant bits in the mask. All network addresses that match this comparison are summarized in a single route advertised by the routing switch.

The <ip-mask> parameter specifies the portions of the IP address that a route must contain to be summarized in the summary route. In the example above, all networks that begin with 209.157 are summarized into a single route.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled OSPF, enable it by clicking on the Enable radio button next to OSPF on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
5. Click on the Area Range link to display the OSPF Area Range configuration panel.
6. Click on the Add Area Range link to display the Area Range panel.

NOTE: If the device already has an OSPF area range, a table listing the ranges is displayed. Click the Modify button to the right of the row describing a range to change its configuration, or click the Add Area Range link to display the OSPF Area Range configuration panel.

7. Enter the area ID in the Area ID field.
8. Enter an IP address in the Network Address field.
9. Enter a network mask in the Mask field. The software compares the address with the significant bits in the mask. All network addresses that match this comparison are summarized in a single route advertised by the routing switch.
10. Click the Add button to add the area.
11. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Assigning Interfaces to an Area

Once you define OSPF areas, you can assign interfaces the areas. All routing switch ports must be assigned to one of the defined areas on an OSPF router. When a port is assigned to an area, all corresponding sub-nets on that port are automatically included in the assignment.

To assign interface 8 of Router A to area 192.5.0.0 and then save the changes, use one the following methods:

USING CLI

To assign interface 8 of Router A to area 192.5.0.0 and then save the changes, enter the following commands:

```
RouterA(config-ospf-router)# interface e8

RouterA(config-if-8)# ip ospf area 192.5.0.0

RouterA(config-if-8)# write memory
```

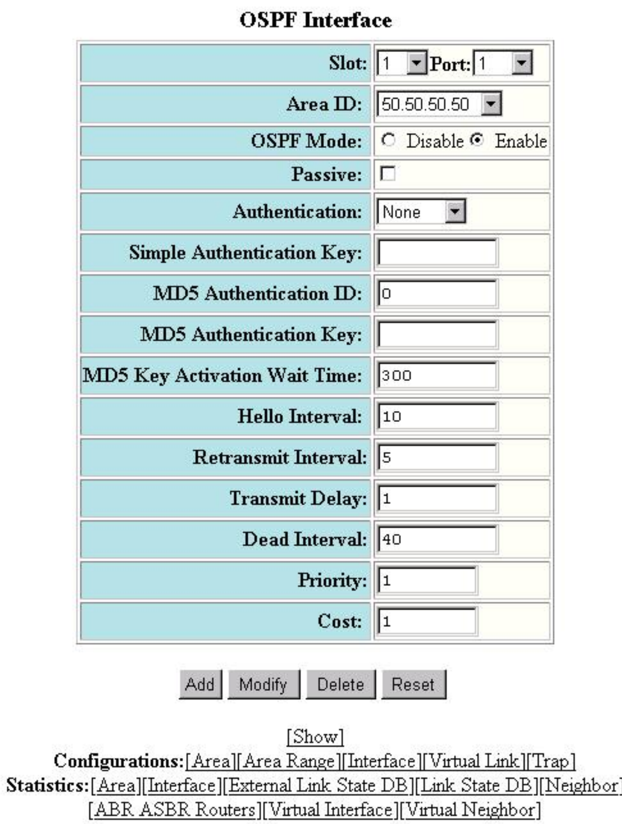
USING WEB MANAGEMENT INTERFACE

All routing switch ports must be assigned to one of the defined areas on an OSPF router. When a port is assigned to an area, all corresponding sub-nets on that port are automatically included in the assignment.

To assign an interface to an area:

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled OSPF, enable it by clicking on the Enable radio button next to OSPF on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.

5. Click on the Interface link.
   - If the device does not have any OSPF interfaces, the OSPF Interface configuration panel is displayed, as shown in the following example.
   - If an OSPF interface is already configured and you are adding a new one, click on the Add OSPF Interface link to display the OSPF Interface configuration panel, as shown in the following example.
   - If you are modifying an existing OSPF interface, click on the Modify button to the right of the row describing the interface to display the OSPF Interface configuration panel, as shown in the following example.



6. Select the port (and slot if applicable) to be assigned to the area from the Port and Slot pulldown menus.

NOTE: If you are configuring a Chassis device (HP 9304M or HP 9308M) a Slot Number pulldown menu will appear on the configuration panel in addition to the Port pulldown menu.

7. Select the IP address of the area to which the interface is to be assigned from the Area ID pull down menu.

NOTE: You must configure the area before you can assign interfaces to it.

8. Select the Enable option of the OSPF mode parameter to enable OSPF on the interface.
9. Click the Add button to save the change to the device's running-config file.
10. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modify Interface Defaults

OSPF has interface parameters that you can configure. For simplicity, each of these parameters has a default value. No change to these default values is required except as needed for specific network configurations.

USING THE CLI

Port default values can be modified using the following CLI commands at the **interface level** of the CLI:

- ip ospf area <ip-addr>
- ip ospf authentication-key <password>
- ip ospf cost <num>
- ip ospf dead-interval <value>
- ip ospf hello-interval <value>
- ip ospf md5-authentication key-activation-wait-time <num> | key-id <num> key <string>
- ip ospf passive
- ip ospf priority <value>
- ip ospf retransmit-interval <value>
- ip ospf transmit-delay <value>

For a complete description of these parameters, see the summary of OSPF port parameters in the next section.

USING THE WEB MANAGEMENT INTERFACE

To modify OSPF port parameters when using the Web:

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled OSPF, enable it by clicking on the Enable radio button next to OSPF on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
5. Click on the Interface link.

NOTE: If the device already has OSPF interfaces, a table listing the interfaces is displayed. Click the Modify button to the right of the row describing the interface to change its configuration, or click the Add OSPF Interface link to display the OSPF Interface configuration panel.

6. Select the port (and slot if applicable) from the pulldown menu(s).
7. Select the area ID from the Area ID pulldown menu.
8. Select the OSPF mode to enable or disable OSPF on the interface.
9. Click on the checkbox next to Passive if you do not want the interface to send or receive OSPF route updates. By default, all OSPF interfaces are active and thus can send and receive OSPF route information. Since a passive interface does not send or receive route information, the interface is in effect a stub network. OSPF interfaces are active by default.
10. Select the authentication method for the interface from the pulldown menu. Options are None, Simple, or MD5.

NOTE: If you select MD5 as the authentication method, enter a value for the MD5 authentication ID, key and key activation time in the associated fields. If you select Simple, enter an authentication key. If you select No Authentication as the authentication method, you do not need to specify anything in the Simple and MD5 fields.

11. Modify the default values of the following interface parameters as needed: hello interval, retransmit interval, transmit delay, dead interval, priority, and cost.
12. Click the Add button (if you are adding a new neighbor) or the Modify button (if you are modifying a neighbor that is already configured) to apply the changes to the device's running-config file.
13. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

OSPF Interface Parameters

The following parameters apply to OSPF interfaces.

Area: Assigns an interface to a specific area. You can assign either an IP address or number to represent an OSPF Area ID. If you assign a number, it can be any value from 0 – 2,147,483,647.

Authentication-key: OSPF supports three methods of authentication for each interface—none, simple password, and MD5. Only one method of authentication can be active on an interface at a time. The default authentication value is none, meaning no authentication is performed.

- The simple password method of authentication requires you to configure an alphanumeric password on an interface. The simple password setting takes effect immediately. All OSPF packets transmitted on the interface contain this password. Any OSPF packet received on the interface is checked for this password. If the password is not present, then the packet is dropped. The password can be up to eight characters long.
- The MD5 method of authentication requires you to configure a key ID and an MD5 Key. The key ID is a number from 1 – 255 and identifies the MD5 key that is being used. The MD5 key can be up to sixteen alphanumeric characters long.

Cost: Indicates the overhead required to send a packet across an interface. You can modify the cost to differentiate between 100 Mbps and 1000 Mbps (1 Gbps) links. The default cost is calculated by dividing 100 million by the bandwidth. For 10 Mbps links, the cost is 10. The cost for both 100 Mbps and 1000 Mbps links is 1, because the speed of 1000 Mbps was not in use at the time the OSPF cost formula was devised.

Dead-interval: Indicates the number of seconds that a neighbor router waits for a hello packet from the current routing switch before declaring the routing switch down. The value can be from 1 – 65535 seconds. The default is 40 seconds.

Hello-interval: Represents the length of time between the transmission of hello packets. The value can be from 1 – 65535 seconds. The default is 10 seconds.

MD5-authentication activation wait time: The number of seconds the routing switch waits until placing a new MD5 key into effect. The wait time provides a way to gracefully transition from one MD5 key to another without disturbing the network. The wait time can be from 0 – 14400 seconds. The default is 300 seconds (5 minutes).

MD5-authentication key ID and key: A method of authentication that requires you to configure a key ID and an MD5 key. The key ID is a number from 1 – 255 and identifies the MD5 key that is being used. The MD5 key consists of up to 16 alphanumeric characters. The MD5 is encrypted and included in each OSPF packet transmitted.

Passive: When you configure an OSPF interface to be passive, that interface does not send or receive OSPF route updates. By default, all OSPF interfaces are active and thus can send and receive OSPF route information. Since a passive interface does not send or receive route information, the interface is in effect a stub network. OSPF interfaces are active by default.

Priority: Allows you to modify the priority of an OSPF router. The priority is used when selecting the designated router (DR) and backup designated routers (BDRs). The value can be from 0 – 255. The default is 1. If you set the priority to 0, the routing switch does not participate in DR and BDR election.

Retransmit-interval: The time between retransmissions of link-state advertisements (LSAs) to adjacent routers for this interface. The value can be from 0 – 3600 seconds. The default is 5 seconds.

Transit-delay: The time it takes to transmit Link State Update packets on this interface. The value can be from 0 – 3600 seconds. The default is 1 second.

Block Flooding of Outbound LSAs on Specific OSPF Interfaces

By default, the routing switch floods all outbound LSAs on all the OSPF interfaces within an area. You can configure a filter to block outbound LSAs on an OSPF interface. This feature is particularly useful when you want to block LSAs from some, but not all, of the interfaces attached to the area.

After you apply filters to block the outbound LSAs, the filtering occurs during the database synchronization and flooding.

If you remove the filters, the blocked LSAs are automatically re-flooded. You do not need to reset OSPF to re-flood the LSAs.

NOTE: You cannot block LSAs on virtual links.

USING THE CLI

To apply a filter to an OSPF interface to block flooding of outbound LSAs on the interface, enter the following command at the Interface configuration level for that interface.

```
HP9300(config-if-1/1)# ip ospf database-filter all out
```

The command in this example blocks all outbound LSAs on the OSPF interface configured on port 1/1.

Syntax: [no] ip ospf database-filter all out

To remove the filter, enter a command such as the following:

```
HP9300(config-if-1/1)# no ip ospf database-filter all out
```

USING THE WEB MANAGEMENT INTERFACE

You cannot configure filters to block flooding on OSPF interfaces using the Web management interface.

Assign Virtual Links

All ABRs (area border routers) must have either a direct or indirect link to the OSPF backbone area (0.0.0.0 or 0). If an ABR does not have a physical link to the area backbone, the ABR can configure a ***virtual link*** to another router within the same area, which has a physical connection to the area backbone.

The path for a virtual link is through an area shared by the neighbor ABR (router with a physical backbone connection), and the ABR requiring a logical connection to the backbone.

Two parameters fields must be defined for all virtual links—transit area ID and neighbor router.

- The ***transit area ID*** represents the shared area of the two ABRs and serves as the connection point between the two routers. This number should match the area ID value.
- The ***neighbor router*** field is the router ID (IP address) of the router that is physically connected to the backbone, when assigned from the router interface requiring a logical connection. When assigning the parameters from the router with the physical connection, the router ID is the IP address of the router requiring a logical connection to the backbone.

NOTE: By default, the HP router ID is the IP address configured on the lowest numbered loopback interface. If the routing switch does not have a loopback interface, the default router ID is the lowest numbered IP address configured on the device. For more information or to change the router ID, see “Changing the Router ID” on page 6-25.

NOTE: When you establish an area virtual link, you must configure it on both of the routers (both ends of the virtual link).

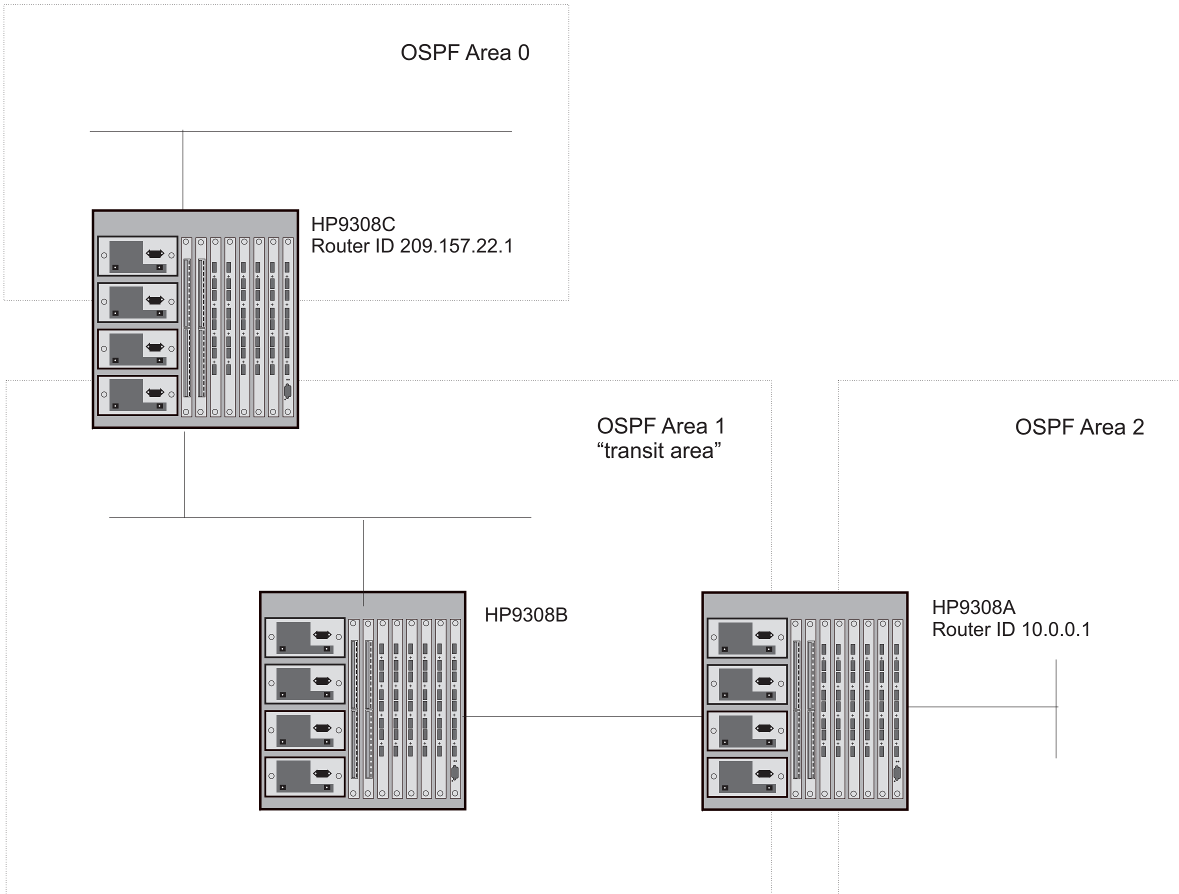


Figure 8.6 Defining OSPF virtual links within a network

USING THE CLI

EXAMPLE:

Figure 8.6 shows an OSPF area border router, HP 9308M-A, that is cut off from the backbone area (area 0). To provide backbone access to HP 9308M-A, you can add a virtual link between HP 9308M-A and HP 9308M-C using area 1 as a transit area. To configure the virtual link, you define the link on the router that is at each end of the link. No configuration for the virtual link is required on the routers in the transit area.

To define the virtual link on HP 9308M-A, enter the following commands:

```
HP9308A(config-ospf-router)# area 1 virtual-link 209.157.22.1

HP9308A(config-ospf-router)# write memory
```

Enter the following commands to configure the virtual link on HP 9308M-C:

```
HP9308C(config-ospf-router)# area 1 virtual-link 10.0.0.1

HP9308C(config-ospf-router)# write memory
```

Syntax: area <ip-addr> | <num> virtual-link <router-id>
[authentication-key | dead-interval | hello-interval | retransmit-interval | transmit-delay <value>]

The **area** <ip-addr> | <num> parameter specifies the transit area.

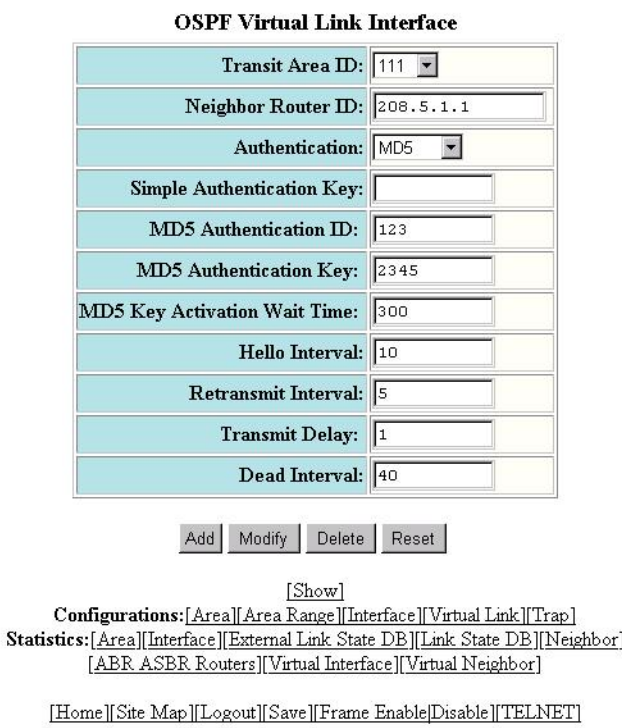
The <router-id> parameter specifies the router ID of the OSPF router at the remote end of the virtual link. To display the router ID on an HP routing switch, enter the **show ip** command.

See “Modify Virtual Link Parameters” on page 8-23 for descriptions of the optional parameters.

USING THE WEB MANAGEMENT INTERFACE

To configure a virtual link:

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled OSPF, enable it by clicking on the Enable radio button next to OSPF on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
5. Click on the Virtual Link link.
    - If the device does not have any OSPF virtual links, the OSPF Virtual Link Interface configuration panel is displayed, as shown in the following example.
    - If an OSPF virtual link is already configured and you are adding a new one, click on the Add OSPF Virtual Link link to display the OSPF Virtual Link Interface configuration panel, as shown in the following example.
    - If you are modifying an existing OSPF virtual link, click on the Modify button to the right of the row describing the virtual link to display the OSPF Virtual Link Interface configuration panel, as shown in the following example.



6. Select the transit area ID from the pulldown menu. The transit area is the area ID of the area shared by both routers.
7. Select an authentication method from the pulldown menu. If you select Simple, enter the authentication key in the appropriate field. If you select MD5, enter the MD5 authentication ID, key, and wait time.

NOTE: For descriptions of the authentication parameters, see "Modify Virtual Link Parameters" on page 8-23.

---

8. Enter the router ID of the neighbor router.
9. Modify the default settings of the following parameters if needed: hello interval, transit delay, retransmit interval and, dead interval.

NOTE: For a description of all virtual link parameters and their possible values, see “Modify Virtual Link Parameters” on page 8-23.

---

10. Click Add to save the change to the device’s running-config file.
11. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.
12. Log onto the neighbor router and configure the other end of the virtual link.

Modify Virtual Link Parameters

OSPF has some parameters that you can modify for virtual links. Notice that these are the same parameters as the ones you can modify for physical interfaces.

USING THE CLI

You can modify default values for virtual links using the following CLI command at the ***OSPF router level*** of the CLI, as shown in the following syntax:

Syntax: area <num> | <ip-addr> virtual-link <ip-addr> [authentication-key <string>] [dead-interval <num>] [hello-interval <num>] [md5-authentication key-activation-wait-time <num> | key-id <num> key <string>] [retransmit-interval <num>] [transmit-delay <num>]

The parameters are described below. For syntax information, see the *Command Line Interface Reference*.

USING THE WEB MANAGEMENT INTERFACE

To modify virtual link default values:

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the Virtual Link link to display a table listing the virtual links.
5. Click on the Modify button to the right of the row describing the virtual link you want to modify. The OSPF Virtual Link Interface configuration panel is displayed.
6. Modify the parameters as needed. (See the following section for descriptions of the parameters.)
7. Click Add to save the change to the device’s running-config file.
8. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.
9. Log on to the neighbor router and configure parameter changes to match those configured for the local routing switch.

Virtual Link Parameter Descriptions

You can modify the following virtual link interface parameters:

Authentication Key: This parameter allows you to assign different authentication methods on a port-by-port basis. OSPF supports three methods of authentication for each interface—none, simple password, and MD5. Only one method of authentication can be active on an interface at a time.

The simple password method of authentication requires you to configure an alphanumeric password on an interface. The password can be up to eight characters long. The simple password setting takes effect immediately. All OSPF packets transmitted on the interface contain this password. All OSPF packets received on the interface are checked for this password. If the password is not present, then the packet is dropped.

The MD5 method of authentication encrypts the authentication key you define. The authentication is included in each OSPF packet transmitted.

MD5 Authentication Key: When simple authentication is enabled, the key is an alphanumeric password of up to eight characters. When MD5 is enabled, the key is an alphanumeric password of up to 16 characters that is later encrypted and included in each OSPF packet transmitted. You must enter a password in this field when the system is configured to operate with either simple or MD5 authentication.

MD5 Authentication Key ID: The Key ID is a number from 1 – 255 and identifies the MD5 key that is being used. This parameter is required to differentiate among multiple keys defined on a routing switch.

MD5 Authentication Wait Time: This parameter determines when a newly configured MD5 authentication key is valid. This parameter provides a graceful transition from one MD5 key to another without disturbing the network. All new packets transmitted after the key activation wait time interval use the newly configured MD5 Key. OSPF packets that contain the old MD5 key are accepted for up to five minutes after the new MD5 key is in operation.

The range for the key activation wait time is from 0 – 14400 seconds. The default value is 300 seconds.

Hello Interval: The length of time between the transmission of hello packets. The range is 1 – 65535 seconds. The default is 10 seconds.

Retransmit Interval: The interval between the re-transmission of link state advertisements to router adjacencies for this interface. The range is 0 – 3600 seconds. The default is 5 seconds.

Transmit Delay: The period of time it takes to transmit Link State Update packets on the interface. The range is 0 – 3600 seconds. The default is 1 second.

Dead Interval: The number of seconds that a neighbor router waits for a hello packet from the current routing switch before declaring the routing switch down. The range is 1 – 65535 seconds. The default is 40 seconds.

Define Redistribution Filters

Route redistribution imports and translates different protocol routes into a specified protocol type. On HP routing switches, redistribution is supported for static routes, OSPF, RIP, and BGP4. When you configure redistribution for RIP, you can specify that static, OSPF, or BGP4 routes are imported into RIP routes. Likewise, OSPF redistribution supports the import of static, RIP, and BGP4 routes into OSPF routes. BGP4 supports redistribution of static, RIP, and OSPF routes into BGP4.

NOTE: The routing switch advertises the default route into OSPF even if redistribution is not enabled, and even if the default route is learned through an IBGP neighbor. IBGP routes (including the default route) are not redistributed into OSPF by OSPF redistribution (for example, by the OSPF **redistribute** command).

In Figure 8.7 on page 8-25, an administrator wants to configure the HP 9308M routing switch acting as the ASBR (Autonomous System Boundary Router) between the RIP domain and the OSPF domain to redistribute routes between the two domains.

NOTE: The ASBR must be running both RIP and OSPF protocols to support this activity.

To configure for redistribution, define the redistribution tables with deny and permit redistribution filters.

- If you are using the CLI, use the **deny** and **permit** redistribute commands for OSPF at the OSPF router level.
- If you are using the Web management interface, click on the plus sign next to Configure in the tree view, click on the plus sign next to OSPF, then select the Redistribution Filter link from the OSPF configuration sheet.

NOTE: Do not enable redistribution until you have configured the redistribution filters. If you enable redistribution before you configure the redistribution filters, the filters will not take affect and all routes will be distributed.

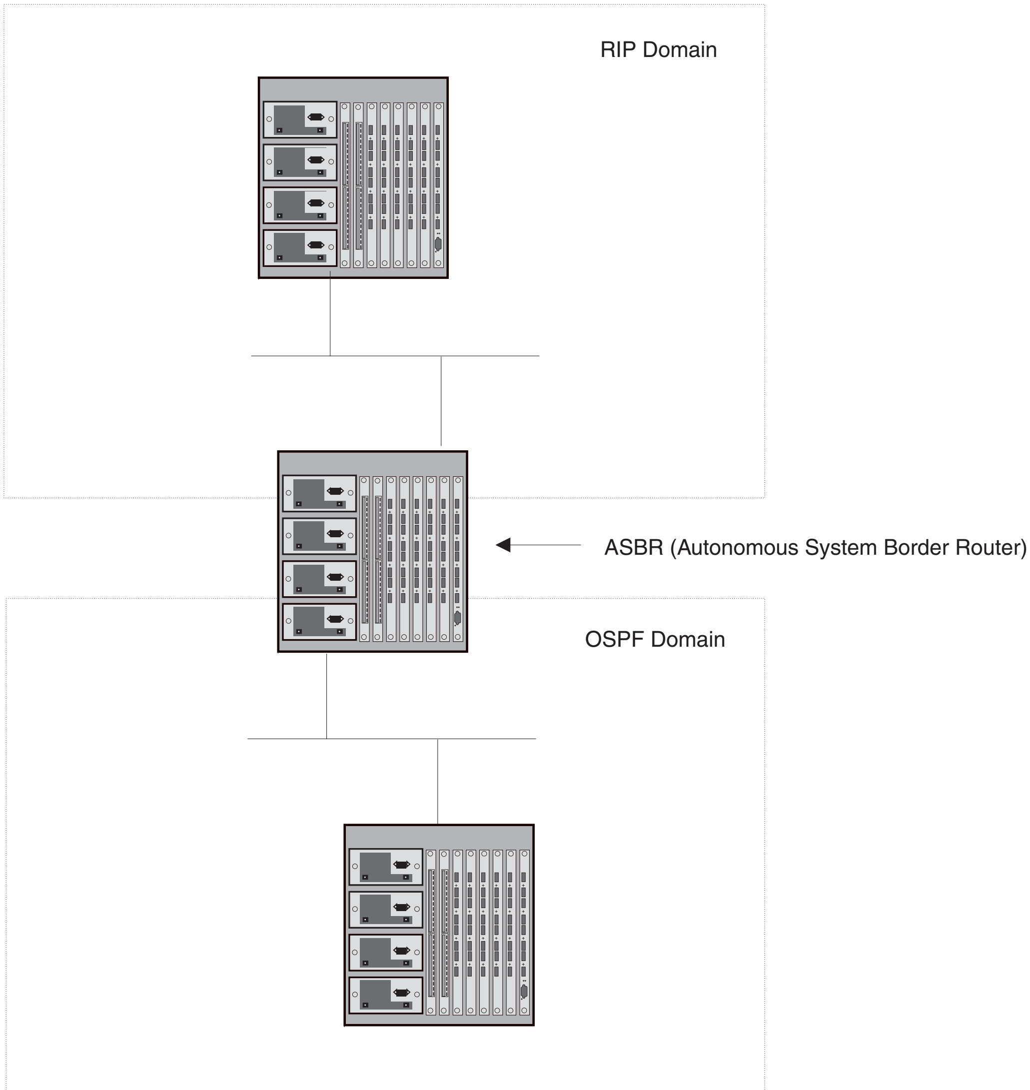


Figure 8.7 Redistributing OSPF and static routes to RIP routes

USING THE CLI

EXAMPLE:

To configure the HP 9308M routing switch acting as an ASBR in Figure 8.7 to redistribute OSPF, BGP4, and static routes into RIP, enter the following commands:

```
HP9300ASBR(config)# router rip

HP9300ASBR(config-rip-router)# permit redistribute 1 all

HP9300ASBR(config-rip-router)# write memory
```

NOTE: Redistribution is permitted for all routes by default, so the **permit redistribute 1 all** command in the example above is shown for clarity but is not required.

You also have the option of specifying import of just OSPF, BGP4, or static routes, as well as specifying that only routes for a specific network or with a specific cost (metric) be imported, as shown in the command syntax below:

Syntax: deny | permit redistribute <filter-num> all | bgp | connected | rip | static [address <ip-addr> <ip-mask> [match-metric <value> [set-metric <value>]]]

EXAMPLE:

To redistribute RIP, static, and BGP4 routes into OSPF, enter the following commands on the routing switch acting as an ASBR:

```
HP9300ASBR(config)# router ospf
HP9300ASBR(config-ospf-router)# permit redistribute 1 all
HP9300ASBR(config-ospf-router)# write memory
```

Syntax: deny | permit redistribute <filter-num> all | bgp | connected | rip | static
address <ip-addr> <ip-mask>
[match-metric <value> | set-metric <value>]

NOTE: Redistribution is permitted for all routes by default, so the **permit redistribute 1 all** command in the example above is shown for clarity but is not required.

You also have the option of specifying import of just OSPF, BGP4, or static routes, as well as specifying that only routes for a specific network or with a specific cost (metric) be imported, as shown in the command syntax below:

Syntax: [no] redistribution bgp | connected | rip | static

For example, to enable redistribution of RIP and static IP routes into OSPF, enter the following commands.

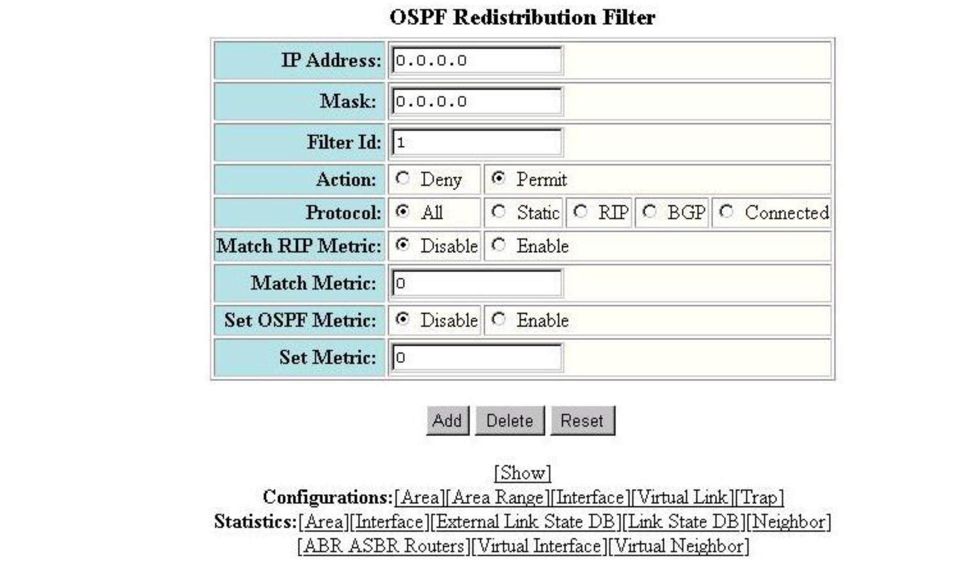
```
HP9300(config)# router ospf
HP9300(config-ospf-router)# redistribution rip
HP9300(config-ospf-router)# redistribution static
HP9300(config-ospf-router)# write memory
```

NOTE: The **redistribution** command does not perform the same function as the **permit redistribute** and **deny redistribute** commands. The **redistribute** commands allow you to control redistribution of routes by filtering on the IP address and network mask of a route. The **redistribution** commands enable redistribution for routes of specific types (static, directly connected, and so on). Configure all your redistribution filters before enabling redistribution.

NOTE: Do not enable redistribution until you have configured the redistribution filters. If you enable redistribution before you configure the redistribution filters, the filters will not take affect and all routes will be distributed.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the Redistribution Filter link.
    - If the device does not have any OSPF redistribution filters, the OSPF Redistribution Filter configuration panel is displayed, as shown in the following example.
    - If an OSPF redistribution filter is already configured and you are adding a new one, click on the Add Redistribution Filter link to display the OSPF Redistribution Filter configuration panel, as shown in the following example.
5. If you are modifying an existing OSPF redistribution filter, click on the Modify button to the right of the row describing the filter to display the OSPF Redistribution Filter configuration panel, as shown in the following example.



6. Optionally, enter the IP address and mask if you want to filter the redistributed routes for a specific network range.
7. Optionally, enter the filter ID or accept the ID value in the Filter ID field.
8. Optionally, select the filter action, Deny or Permit. The default is Permit.
9. Optionally, select the types of routes the filter applies to in the Protocol section. You can select one of the following:
    - All (the default)
    - Static
    - RIP
    - BGP
    - Connected
10. Optionally, enable matching on RIP metric and enter the metric.
11. Optionally, enable setting the OSPF metric for the imported routes and specify the metric.
12. Click the Add button to apply the filter to the device’s running-config file.
13. Select the <u>Save</u> link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Modify Default Metric for Redistribution

The default metric is a global parameter that specifies the cost applied to all OSPF routes by default. The default value is 10. You can assign a cost from 1 – 15.

NOTE: You also can define the cost on individual interfaces. The interface cost overrides the default cost.

USING THE CLI

To assign a default metric of 4 to all routes imported into OSPF, enter the following commands:

```
HP9300(config)# router ospf
HP9300(config-ospf-router)# default-metric 4
```

Syntax: default-metric <value>

The <value> can be from 1 – 16,777,215. The default is 10.

USING THE WEB MANAGEMENT INTERFACE

To modify the cost that is assigned to redistributed routes:

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the Redistribution Filter link to display a table listing the redistribution filters.
5. Click on the Modify button to the right of the row describing the virtual link you want to modify. The OSPF Virtual Link Interface configuration panel is displayed.
6. Enter a value from 1 – 15 in the Default Metric field.
7. Click Add to save the change to the device's running-config file.
8. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Enable Route Redistribution

To enable route redistribution, use one of the following methods.

NOTE: Do not enable redistribution until you have configured the redistribution filters. Otherwise, you might accidentally overload the network with routes you did not intend to redistribute.

USING THE CLI

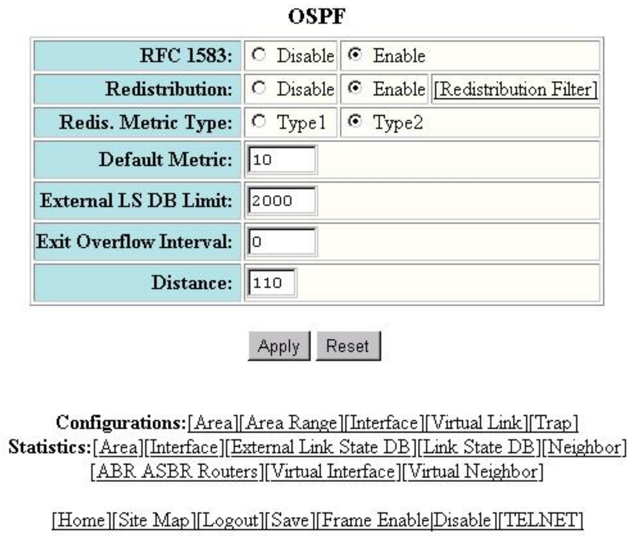
To enable redistribution of RIP and static IP routes into OSPF, enter the following commands.

```
HP9300(config)# router ospf
HP9300(config-ospf-router)# redistribution rip
HP9300(config-ospf-router)# redistribution static
HP9300(config-ospf-router)# write memory
```

Syntax: [no] redistribution bgp | connected | rip | static

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of BGP option links.
4. Click on the General link to display the OSPF configuration panel, as shown in the following figure.



5. Select the Enable radio button next to Redistribution.
6. Click the Apply button to apply the change to the device’s running-config file.
7. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Disable or Re-enable Load Sharing

HP routing switches can load share among up to eight equal-cost IP routes to a destination. By default, IP load sharing is enabled. The default is 4 equal-cost paths but you can specify from 2 – 8 paths.

The routing switch software can use the route information it learns through OSPF to determine the paths and costs. Figure 8.8 shows an example of an OSPF network containing multiple paths to a destination (in this case, R1).

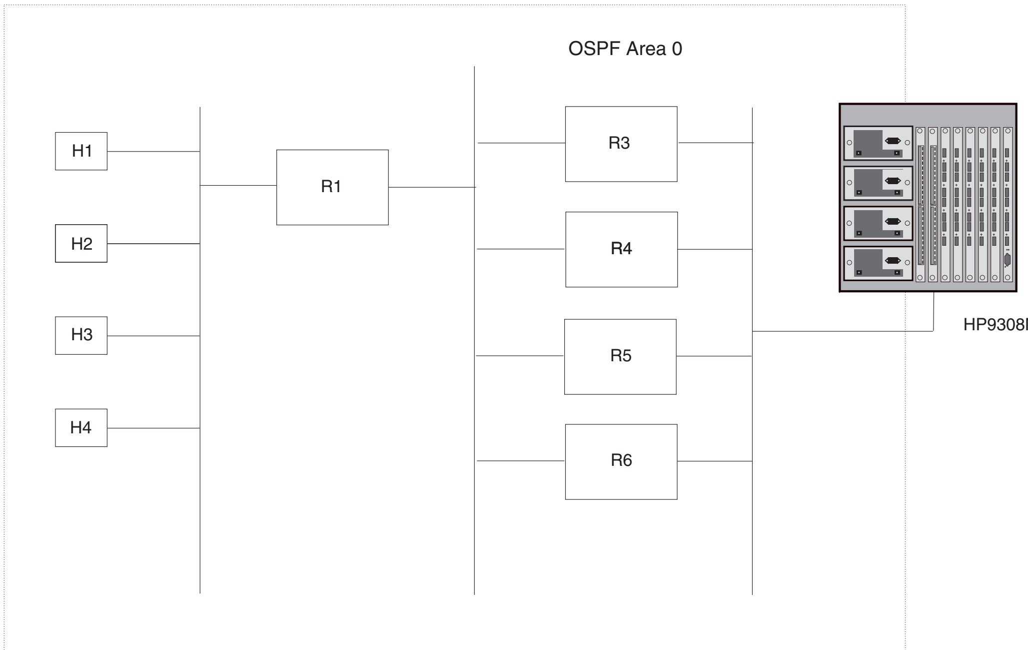


Figure 8.8 Example OSPF network with four equal-cost paths

In the example in Figure 8.8, the HP routing switch has four paths to R1:

- HP9308M->R3
- HP9308M->R4
- HP9308M->R5
- HP9308M->R6

Normally, the HP routing switch will choose the path to the R1 with the lower metric. For example, if R3's metric is 1400 and R4's metric is 600, the HP routing switch will always choose R4.

However, suppose the metric is the same for all four routing switches in this example. If the costs are the same, the routing switch now has four equal-cost paths to R1. To allow the routing switch to load share among the equal cost routes, enable IP load sharing. The software supports four equal-cost OSPF paths by default when you enable load sharing. You can specify from 2 – 8 paths.

NOTE: The HP routing switch is not source routing in these examples. The routing switch is concerned only with the paths to the next-hop routers, not the entire paths to the destination hosts.

OSPF load sharing is enabled by default when IP load sharing is enabled. To configure IP load sharing parameters, see "Configuring IP Load Sharing" on page 6-48.

Configure External Route Summarization

When the routing switch is an OSPF Autonomous System Boundary Router (ASBR), you can configure it to advertise one external route as an aggregate for all redistributed routes that are covered by a specified address range.

When you configure an address range, the range takes effect immediately. All the imported routes are summarized according to the configured address range. Imported routes that have already been advertised and that fall within the range are flushed out of the AS and a single route corresponding to the range is advertised.

If a route that falls within a configured address range is imported by the routing switch, no action is taken if the routing switch has already advertised the aggregate route; otherwise the routing switch advertises the aggregate route. If an imported route that falls with in a configured address range is removed by the routing switch, no action is taken if there are other imported route(s) that fall with in the same address range; otherwise the aggregate route is flushed.

You can configure up to 32 address ranges. The routing switch sets the forwarding address of the aggregate route to zero and sets the tag to zero.

If you delete an address range, the advertised aggregate route is flushed and all imported routes that fall within the range are advertised individually.

If an external LSDB overflow condition occurs, all aggregate routes are flushed out of the AS, along with other external routes. When the routing switch exits the external LSDB overflow condition, all the imported routes are summarized according to the configured address ranges.

NOTE: If you use redistribution filters in addition to address ranges, the routing switch applies the redistribution filters to routes first, then applies them to the address ranges.

NOTE: If you disable redistribution, all the aggregate routes are flushed, along with other imported routes.

NOTE: This option affects only imported, type 5 external routes. A single type 5 LSA is generated and flooded throughout the AS for multiple external routes. Type 7-route redistribution is not affected by this feature. All type 7 routes will be imported (if redistribution is enabled). To summarize type 7 LSAs or exported routes, use NSSA address range summarization.

To configure route summarization, use the following CLI method.

USING THE CLI

To configure a summary address for OSPF routes, enter commands such as the following:

```
HP9300(config-ospf-router)# summary-address 10.1.0.0 255.255.0.0
```

The command in this example configures summary address 10.1.0.0, which includes addresses 10.1.1.0, 10.1.2.0, 10.1.3.0, and so on. For all of these networks, only the address 10.1.0.0 is advertised in external LSAs.

Syntax: summary-address <ip-addr> <ip-mask>

The <ip-addr> parameter specifies the network address.

The <ip-mask> parameter specifies the network mask.

To display the configured summary addresses, enter the following command at any level of the CLI:

```
HP9300(config-ospf-router)# show ip ospf config

OSPF Redistribution Address Ranges currently defined:

Range-Address    Subnetmask
1.0.0.0          255.0.0.0
1.0.1.0          255.255.255.0
1.0.2.0          255.255.255.0
```

Syntax: show ip ospf config

USING THE WEB MANAGEMENT INTERFACE

You cannot configure OSPF route summarization using the Web management interface.

Configure Default Route Origination

When the routing switch is an OSPF Autonomous System Boundary Router (ASBR), you can configure it to automatically generate a default external route into an OSPF routing domain. This feature is called “default route origination” or “default information origination”.

By default, HP routing switches do not advertise the default route into the OSPF domain. If you want the routing switch to advertise the OSPF default route, you must explicitly enable default route origination.

When you enable OSPF default route origination, the routing switch advertises a type 5 default route that is flooded throughout the AS (except stub areas and NSSAs). In addition, internal NSSA ASBRs advertise their default routes as translatable type 7 default routes.

The routing switch advertises the default route into OSPF even if OSPF route redistribution is not enabled, and even if the default route is learned through an IBGP neighbor.

NOTE: HP routing switches never advertise the OSPF default route, regardless of other configuration parameters, unless you explicitly enable default route origination using the following method.

If the routing switch is an ASBR, you can use the “always” option when you enable the default route origination. The always option causes the ASBR to create and advertise a default route if it does not already have one configured.

If default route origination is enabled and you disable it, the default route originated by the routing switch is flushed. Default routes generated by other OSPF routers are not affected. If you re-enable the feature, the feature takes effect immediately and thus does not require you to reload the software.

To enable default route origination, use the following CLI method.

USING THE CLI

To enable default route origination, enter the following command:

```
HP9300(config-ospf-router)# default-information-originate
```

To disable the feature, enter the following command:

```
HP9300(config-ospf-router)# no default-information-originate
```

Syntax: [no] default-information-originate [always] [metric <value>] [metric-type <type>]

The **always** parameter advertises the default route regardless of whether the routing switch has a default route. This option is disabled by default.

The **metric** <value> parameter specifies a metric for the default route. If this option is not used, the default metric is used for the route.

The **metric-type** <type> parameter specifies the external link type associated with the default route advertised into the OSPF routing domain. The <type> can be one of the following:

- 1 – Type 1 external route
- 2 – Type 2 external route

If you do not use this option, the default redistribution metric type is used for the route type.

NOTE: If you specify a metric and metric type, the values you specify are used only if the routing switch does not have a default route, but still wants to advertise one because the **always** option is configured.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure OSPF default route origination using the Web management interface.

Modify SPF Timers

The routing switch uses the following timers when calculating the shortest path for OSPF routes:

- SPF delay - When the routing switch receives a topology change, the software waits before it starts a Shortest Path First (SPF) calculation. By default, the software waits five seconds. You can configure the SPF delay to a value from 0 – 65535 seconds. If you set the SPF delay to 0 seconds, the software immediately begins the SPF calculation after receiving a topology change.
- SPF hold time - The routing switch waits for a specific amount of time between consecutive SPF calculations. By default, the routing switch waits ten seconds. You can configure the SPF hold time to a value from 0 – 65535 seconds. If you set the SPF hold time to 0 seconds, the software does not wait between consecutive SPF calculations.

You can set the delay and hold time to lower values to cause the routing switch to change to alternate paths more quickly in the event of a route failure. Note that lower values require more CPU processing time.

You can change one or both of the timers. To do so, use the following CLI method.

USING THE CLI

To change the SPF delay and hold time, enter commands such as the following:

```
HP9300(config-ospf-router)# timers spf 10 20
```

The command in this example changes the SPF delay to 10 seconds and changes the SPF hold time to 20 seconds.

Syntax: timers spf <delay> <hold-time>

The <delay> parameter specifies the SPF delay.

The <hold-time> parameter specifies the SPF hold time.

To set the timers back to their default values, enter a command such as the following:

```
HP9300(config-ospf-router)# no timers spf 10 20
```

USING THE WEB MANAGEMENT INTERFACE

You cannot configure the SPF timers using the Web management interface.

Modify Redistribution Metric Type

The redistribution metric type is used by default for all routes imported into OSPF unless you specify different metrics for individual routes using redistribution filters. Type 2 specifies a big metric (three bytes). Type 1 specifies a small metric (two bytes). The default value is type 2.

USING THE CLI

To modify the default value to type 1, enter the following command:

```
HP9300(config-ospf-router)# metric-type type1
```

Syntax: metric-type type1 | type2

The default is **type2**.

USING THE WEB MANAGEMENT INTERFACE

To modify the default metric type:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the General link to display the OSPF configuration panel.
5. Select either Type 1 or Type 2 for the redistribution metric type.

6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modify Administrative Distance

HP routing switches can learn about networks from various protocols, including Border Gateway Protocol version 4 (BGP4), RIP, and OSPF. Consequently, the routes to a network may differ depending on the protocol from which the routes were learned. The default administrative distance for OSPF routes is 110. See "Changing Administrative Distances" on page 10-30 for a list of the default distances for all route sources.

The routing switch selects one route over another based on the source of the route information. To do so, the routing switch can use the administrative distances assigned to the sources. You can bias the routing switch's decision by changing the default administrative distance for RIP routes.

Configuring Administrative Distance Based on Route Type

You can configure a unique administrative distance for each type of OSPF route. For example, you can use this feature to prefer a static route over an OSPF inter-area route but you also want to prefer OSPF intra-area routes to static routes.

The distance you specify influences the choice of routes when the routing switch has multiple routes for the same network from different protocols. The routing switch prefers the route with the lower administrative distance.

You can specify unique default administrative distances for the following route types:

- Intra-area routes
- Inter-area routes
- External routes

The default for all these OSPF route types is 110.

NOTE: This feature does not influence the choice of routes within OSPF. For example, an OSPF intra-area route is always preferred over an OSPF inter-area route, even if the intra-area route's distance is greater than the inter-area route's distance.

To configure administrative distances for OSPF route types, use the following CLI method.

USING THE CLI

To change the default administrative distances for inter-area routes, intra-area routes, and external routes, enter the following command:

```
HP9300(config-ospf-router)# distance external 100
HP9300(config-ospf-router)# distance inter-area 90
HP9300(config-ospf-router)# distance intra-area 80
```

Syntax: distance external | inter-area | intra-area <distance>

The **external | inter-area | intra-area** parameter specifies the route type for which you are changing the default administrative distance.

The <distance> parameter specifies the new distance for the specified route type. Unless you change the distance for one of the route types using commands such as those shown above, the default is 110.

To reset the administrative distance to its system default (110), enter a command such as the following:

```
HP9300(config-ospf-router)# no distance external 100
```

Configure OSPF Group Link State Advertisement (LSA) Pacing

The routing switch paces LSA refreshes by delaying the refreshes for a specified time interval instead of performing a refresh each time an individual LSA's refresh timer expires. The accumulated LSAs constitute a group, which the routing switch refreshes and sends out together in one or more packets.

The pacing interval, which is the interval at which the routing switch refreshes an accumulated group of LSAs, is configurable to a range from 10 – 1800 seconds (30 minutes). The default is 240 seconds (four minutes). Thus, every four minutes, the routing switch refreshes the group of accumulated LSAs and sends the group together in the same packet(s).

Usage Guidelines

The pacing interval is inversely proportional to the number of LSAs the routing switch is refreshing and aging. For example, if you have approximately 10,000 LSAs, decreasing the pacing interval enhances performance. If you have a very small database (40 – 100 LSAs), increasing the pacing interval to 10 – 20 minutes might enhance performance slightly.

Changing the LSA Pacing Interval

To change the LSA pacing interval, use the following CLI method.

USING THE CLI

To change the LSA pacing interval to two minutes (120 seconds), enter the following command:

```
HP9300(config-ospf-router)# timers lsa-group-pacing 120
```

Syntax: [no] timers lsa-group-pacing <secs>

The <secs> parameter specifies the number of seconds and can be from 10 – 1800 (30 minutes). The default is 240 seconds (four minutes).

To restore the pacing interval to its default value, enter the following command:

```
HP9300(config-ospf-router)# no timers lsa-group-pacing
```

USING THE WEB MANAGEMENT INTERFACE

You cannot configure this option using the Web management interface.

Modify OSPF Traps Generated

OSPF traps as defined by RFC 1850 are supported on HP routing switches. OSPF trap generation is enabled on the routing switch, by default.

USING THE CLI

When using the CLI, you can disable all or specific OSPF trap generation by entering the following CLI command:

```
HP9300(config-ospf-router)# no snmp-server trap ospf
```

To later re-enable the trap feature, enter **snmp-server trap ospf**.

To disable a specific OSPF trap, enter the command as **no snmp-server trap ospf** <ospf-trap>.

These commands are at the OSPF router Level of the CLI.

Here is a summary of OSPF traps supported on HP routing switches, their corresponding CLI commands, and their associated MIB objects from RFC 1850:

- **interface-state-change-trap** [MIB object: OspfIfstateChange]
- **virtual-interface-state-change-trap** [MIB object: OspfVirtIfStateChange
- **neighbor-state-change-trap** [MIB object:ospfNbrStateChange]
- **virtual-neighbor-state-change-trap** [MIB object: ospfVirtNbrStateChange]
- **interface-config-error-trap** [MIB object: ospfIfConfigError]
- **virtual-interface-config-error-trap** [MIB object: ospfVirtIfConfigError]
- **interface-authentication-failure-trap** [MIB object: ospfIfAuthFailure]
- **virtual-interface-authentication-failure-trap** [MIB object: ospfVirtIfAuthFailure]
- **interface-receive-bad-packet-trap** [MIB object: ospfIfrxBadPacket]

- **virtual-interface-receive-bad-packet-trap** [MIB object: ospfVirtIfRxBadPacket]
- **interface-retransmit-packet-trap** [MIB object: ospfTxRetransmit]
- **virtual-interface-retransmit-packet-trap** [MIB object: ospfVirtIfTxRetransmit]
- **originate-lsa-trap** [MIB object: ospfOriginateLsa]
- **originate-maxage-lsa-trap** [MIB object: ospfMaxAgeLsa]
- **link-state-database-overflow-trap** [MIB object: ospfLsdbOverflow]
- **link-state-database-approaching-overflow-trap** [MIB object: ospfLsdbApproachingOverflow

EXAMPLE:

To stop an OSPF trap from being collected, use the CLI command: **no trap** <ospf-trap>, at the OSPF router level of the CLI. To disable reporting of the neighbor-state-change-trap, enter the following command:

```
HP9300(config-ospf-router)# no trap neighbor-state-change-trap
```

EXAMPLE:

To reinstate the trap, enter the following command:

```
HP9300(config-ospf-router)# trap neighbor-state-change-trap
```

Syntax: [no] snmp-server trap ospf <ospf-trap>

USING THE WEB MANAGEMENT INTERFACE

To disable a specific OSPF trap or traps:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the Trap link to display the OSPF Trap panel.
5. Select the Disable radio button beside each OSPF trap you want to disable.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modify OSPF Standard Compliance Setting

HP routing switch are configured, by default, to be compliant with the RFC 1583 OSPF V2 specification.

USING THE CLI

To configure a routing switch to operate with the latest OSPF standard, RFC 2178, enter the following commands:

```
HP9300(config)# router ospf
HP9300(config-ospf-router)# no rfc1583-compatibility
```

Syntax: [no] rfc1583-compatibility

USING THE WEB MANAGEMENT INTERFACE

To configure a routing switch to operate with the latest OSPF standard, RFC 2178:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the General link to display the OSPF configuration panel.

5. Select Disable next to RFC 1583.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modify Exit Overflow Interval

If a database overflow condition occurs on a routing switch, the routing switch eliminates the condition by removing entries that originated on the routing switch. The exit overflow interval allows you to set how often a routing switch checks to see if the overflow condition has been eliminated. The default value is 0. The range is 0 – 86400 seconds (24 hours). If the configured value of the database overflow interval is zero, then the routing switch never leaves the database overflow condition.

NOTE: The software dynamically allocates OSPF memory as needed. See "Dynamic OSPF Memory" on page 8-6.

USING THE CLI

To modify the exit overflow interval to 60 seconds, enter the following command:

```
HP9300(config-ospf-router)# data-base-overflow-interval 60
```

Syntax: database-overflow-interval <value>

The <value> can be from 0 – 86400 seconds. The default is 0 seconds.

USING THE WEB MANAGEMENT INTERFACE

To modify the exit overflow interval:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the General link to display the OSPF configuration panel.
5. Enter a value from 0 – 86400 in the Exit Overflow Interval field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modify the Maximum Number of Routes

NOTE: This section applies only to devices that are running software earlier than release 07.1.10. See "Dynamic OSPF Memory" on page 8-6.

The OSPF route table holds 16000 routes by default. You can change the maximum number of routes the routing switch's OSPF table can hold to a value from 4000 – 32000.

USING THE CLI

To change the maximum number of OSPF routes to 32000, enter the following command:

```
HP9300(config-ospf-router)# max-routes 32000
HP9300(config-ospf-router)# exit
HP9300# reload
```

Syntax: `max-routes <num>`

The <num> indicates the number of OSPF routes allowed and can be from 4000 – 32000. The change takes effect after the routing switch is rebooted.

USING THE WEB MANAGEMENT INTERFACE

You cannot modify the maximum number of OSPF routes using the Web management interface.

Modify LSDB Limits

NOTE: This section applies only to devices that are running software earlier than release 07.1.10. See “Dynamic OSPF Memory” on page 8-6.

On routing switches with 32MB or greater memory, you can modify the number of link-state advertisements (LSAs) that the routing switch allows before a database overflow condition is declared on the system. These parameters are part of the routing switch’s compliance with RFC 1765.

The following table lists the types of LSAs for which you can configure the table sizes, the default number of entries the tables can hold, and the range of maximum values you can specify. You cannot configure the LSA tables globally; you must configure them for individual LSA types. Make sure you save the running-config file and reload after changing a table size. The change does not take effect until you reload or reboot.

Table 8.1: Configurable LSA Table Sizes

LSA Type	Default Maximum Number of Entries	Range of Values
External (type 5)	2000	500 – 8000
Network (type 2)	2000	200 – 2000
Router (type 1)	2200	200 – 2200
Summary (type 3 and type 4)	2000	500 – 8000 (NA) 500 – 18000 (HP 9304M or HP 9308M,HP 6308M-SX)

USING THE CLI

To change the maximum number of summary LSA entries from 2000 to 18000, enter the following commands:

```
HP9300(config-ospf-router)# maximum-number-of-lsa summary 18000
HP9300(config-ospf-router)# write memory
HP9300(config-ospf-router)# exit
```

Syntax: maximum-number-of-lsa external | network | router | summary <value>

USING THE WEB MANAGEMENT INTERFACE

To modify the number of IP OSPF external link state advertisements:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the General link to display the OSPF configuration panel.
5. Enter a value from 500 – 8000 in the External LSDB Limit field.
6. Click the Apply button to save the change to the device’s running-config file.

7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Displaying OSPF Information

You can use CLI commands and Web management options to display the following OSPF information:

- Trap, area, and interface information – see "Displaying General OSPF Configuration Information" on page 8-39.
- Area information – see "Displaying OSPF Area Information" on page 8-40.
- Neighbor information – see "Displaying OSPF Neighbor Information" on page 8-41.
- Interface information – see "Displaying OSPF Interface Information" on page 8-43.
- Route information – see "Displaying OSPF Route Information" on page 8-43.
- External link state information – see "Displaying OSPF External Link State Information" on page 8-45.
- Link state information – see "Displaying OSPF Link State Information" on page 8-46.
- Virtual Neighbor information – see "Displaying OSPF Virtual Neighbor Information" on page 8-47.
- Virtual Link information – see "Displaying OSPF Virtual Link Information" on page 8-47.
- ABR and ASBR information – see "Displaying OSPF ABR and ASBR Information" on page 8-48.
- Trap state information – see "Displaying OSPF Trap Status" on page 8-48.

Displaying General OSPF Configuration Information

To display general OSPF configuration information, enter the following command at any CLI level:

```
HP9300> show ip ospf config

Router OSPF: Enabled
Redistribution: Disabled
Default OSPF Metric: 10
OSPF Redistribution Metric: Type2

OSPF External LSA Limit: 25000

OSPF Database Overflow Interval: 0

RFC 1583 Compatibility: Enabled

Router id: 207.95.11.128

Interface State Change Trap:                        Enabled
Virtual Interface State Change Trap:                Enabled
Neighbor State Change Trap:                         Enabled
Virtual Neighbor State Change Trap:                 Enabled
Interface Configuration Error Trap:                 Enabled
Virtual Interface Configuration Error Trap:         Enabled
Interface Authentication Failure Trap:              Enabled
Virtual Interface Authentication Failure Trap:      Enabled
Interface Receive Bad Packet Trap:                  Enabled
Virtual Interface Receive Bad Packet Trap:          Enabled
Interface Retransmit Packet Trap:                   Enabled
Virtual Interface Retransmit Packet Trap:           Enabled
Originate LSA Trap:                                 Enabled
Originate MaxAge LSA Trap:                          Enabled
Link State Database Overflow Trap:                  Enabled
```

```
Link State Database Approaching Overflow Trap:    Enabled

OSPF Area currently defined:
Area-ID          Area-Type Cost
0                normal    0

OSPF Interfaces currently defined:
Ethernet Interface: 3/1-3/2
ip ospf md5-authentication-key-activation-wait-time 300
ip ospf cost 0
ip ospf area 0

Ethernet Interface: v1
ip ospf md5-authentication-key-activation-wait-time 300
ip ospf cost 0
ip ospf area 0
```

Syntax: show ip ospf config

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the General link to display the OSPF configuration panel.

Displaying OSPF Area Information

To display global OSPF area information for the routing switch, use one of the following methods.

USING THE CLI

To display OSPF area information, enter the following command at any CLI level:

```
HP9300> show ip ospf area

Indx  Area       Type   Cost   SPFR ABR ASBR LSA Chksum(Hex)
1   0.0.0.0      normal  0      1     0     0   1   0000781f
2  192.147.60.0 normal  0      1     0     0   1   0000fee6
3  192.147.80.0 stub    1      1     0     0   2   000181cd
```

Syntax: show ip ospf area [<area-id>] | [<num>]

The <area-id> parameter shows information for the specified area.

The <num> parameter displays the entry that corresponds to the entry number you enter. The entry number identifies the entry's position in the area table.

This display shows the following information.

Table 8.2: CLI Display of OSPF Area Information

This Field...	Displays...
Indx	The row number of the entry in the routing switch's OSPF area table.
Area	The area number.

Table 8.2: CLI Display of OSPF Area Information (Continued)

This Field...	Displays...
Type	The area type, which can be one of the following: • nssa • normal • stub
Cost	The area's cost.
SPFR	The SPFR value.
ABR	The ABR number.
ASBR	The ABSR number.
LSA	The LSA number.
Chksum(Hex)	The checksum for the LSA packet. The checksum is based on all the fields in the packet except the age field. The routing switch uses the checksum to verify that the packet is not corrupted.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the Area link.

Displaying OSPF Neighbor Information

To display OSPF neighbor information for the routing switch, use one of the following methods.

USING THE CLI

To display OSPF neighbor information, enter the following command at any CLI level:

```
HP9300> show ip ospf neighbor

Port Address         Pri State      Neigh Address   Neigh ID        Ev Opt Cnt
8    212.76.7.251    1   full       212.76.7.200    173.35.1.220    23 2   0
```

Syntax: show ip ospf neighbor [router-id <ip-addr>] | [<num>]

The **router-id** <ip-addr> parameter displays only the neighbor entries for the specified routing switch.

The <num> parameter displays only the entry in the specified index position in the neighbor table. For example, if you enter “1”, only the first entry in the table is displayed.

This display shows the following information.

Table 8.3: CLI Display of OSPF Neighbor Information

Field	Description
Port	The port through which the routing switch is connected to the neighbor.
Address	The IP address of this routing switch's interface with the neighbor.

Table 8.3: CLI Display of OSPF Neighbor Information (Continued)

Field	Description
Pri	The OSPF priority of the neighbor. The priority is used during election of the Designated Router (DR) and Backup designated Router (BDR).
State	The state of the conversation between the routing switch and the neighbor. This field can have one of the following values: • Down – The initial state of a neighbor conversation. This value indicates that there has been no recent information received from the neighbor. • Attempt – This state is only valid for neighbors attached to non-broadcast networks. It indicates that no recent information has been received from the neighbor. • Init – A Hello packet has recently been seen from the neighbor. However, bidirectional communication has not yet been established with the neighbor. (The routing switch itself did not appear in the neighbor's Hello packet.) All neighbors in this state (or higher) are listed in the Hello packets sent from the associated interface. • 2-Way – Communication between the two routers is bidirectional. This is the most advanced state before beginning adjacency establishment. The Designated Router and Backup Designated Router are selected from the set of neighbors in the 2-Way state or greater. • ExStart – The first step in creating an adjacency between the two neighboring routers. The goal of this step is to decide which router is the master, and to decide upon the initial Database Description (DD) sequence number. Neighbor conversations in this state or greater are called adjacencies. • Exchange – The routing switch is describing its entire link state database by sending Database Description packets to the neighbor. Each Database Description packet has a DD sequence number, and is explicitly acknowledged. Only one Database Description packet can be outstanding at any time. In this state, Link State Request packets can also be sent asking for the neighbor's more recent advertisements. All adjacencies in Exchange state or greater are used by the flooding procedure. In fact, these adjacencies are fully capable of transmitting and receiving all types of OSPF routing protocol packets. • Loading – Link State Request packets are sent to the neighbor asking for the more recent advertisements that have been discovered (but not yet received) in the Exchange state. • Full – The neighboring routers are fully adjacent. These adjacencies will now appear in router links and network link advertisements.
Neigh Address	The IP address of the neighbor.
Neigh ID	The OSPF router ID.
Ev	The number of times the neighbor’s state changed.
Opt	The sum of the option bits in the Options field of the Hello packet. This information is used by HP technical support. See Section A.2 in RFC 2178 for information about the Options field in Hello packets.
Cnt	The number of LSAs that need to retransmitted.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.

3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the Neighbor link.

Displaying OSPF Interface Information

To display OSPF interface information for the routing switch, use one of the following methods.

USING THE CLI

To display OSPF interface information, enter the following command at any CLI level:

```
HP9300> show ip ospf interface
```

Syntax: show ip ospf interface [<ip-addr>]

The <ip-addr> parameter displays the OSPF interface information for the specified IP address.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the Interface link.

Displaying OSPF Route Information

To display OSPF route information for the routing switch, use one of the following methods.

USING THE CLI

To display OSPF route information, enter the following command at any CLI level:

```
HP9300> show ip ospf routes

Index Destination     Mask            Path_Cost Type2_Cost Path_Type
1     212.95.7.0      255.255.255.0   1         0          Intra
      Adv_Router      Link_State      Dest_Type State      Tag       Flags
      173.35.1.220    212.95.7.251    Network   Valid      00000000  7000
      Paths Out_Port  Next_Hop        Type      Arp_Index  State
      1     5/6       209.95.7.250    OSPF      8          84 00

Index Destination     Mask            Path_Cost Type2_Cost Path_Type
2     11.3.63.0       255.255.255.0   11        0          Inter
      Adv_Router      Link_State      Dest_Type State      Tag       Flags
      209.95.7.250    11.3.63.0       Network   Valid      00000000  0000
      Paths Out_Port  Next_Hop        Type      Arp_Index  State
      1     5/6       209.95.7.250    OSPF      8          84 00
```

Syntax: show ip ospf routes [<ip-addr>]

The <ip-addr> parameter specifies a destination IP address. If you use this parameter, only the route entries for that destination are shown.

This display shows the following information.

Table 8.4: CLI Display of OSPF Route Information

This Field...	Displays...
Index	The row number of the entry in the routing switch's OSPF route table.
Destination	The IP address of the route's destination.

Table 8.4: CLI Display of OSPF Route Information (Continued)

This Field...	Displays...
Mask	The network mask for the route.
Path_Cost	The cost of this route path. (A route can have multiple paths. Each path represents a different exit port for the routing switch.)
Type2_Cost	The type 2 cost of this path.
Path_Type	The type of path, which can be one of the following: • Inter – The path to the destination passes into another area. • Intra – The path to the destination is entirely within the local area. • External1 – The path to the destination is a type 1 external route. • External2 – The path to the destination is a type 2 external route.
Adv_Router	The OSPF router that advertised the route to this HP routing switch.
Link-State	The link state from which the route was calculated.
Dest_Type	The destination type, which can be one of the following: • ABR – Area Border Router • ASBR – Autonomous System Boundary Router • Network – the network
State	The route state, which can be one of the following: • Changed • Invalid • Valid This information is used by HP technical support.
Tag	The external route tag.
Flags	State information for the route entry. This information is used by HP technical support.
Paths	The number of paths to the destination.
Out_Port	The port through which the routing switch reaches the next hop for this route path.
Next_Hop	The IP address of the next-hop router for this path.
Type	The route type, which can be one of the following: • OSPF • Static Replaced by OSPF
Arp_Index	The index position in the ARP table of the ARP entry for this path's IP address.
State	State information for the path. This information is used by HP technical support.

USING THE WEB MANAGEMENT INTERFACE

You cannot display the OSPF route table using the Web management interface.

Displaying OSPF External Link State Information

To display external link state information for the routing switch, use one of the following methods.

USING THE CLI

To display external link state information, enter the following command at any CLI level:

```
HP9300> show ip ospf database external-link-state

Ospf ext link-state by router ID 130.130.130.241 are in the following:

Area ID         Aging  LS ID           Router          Seq(hex) Chksum   Type
0.0.0.0         279    130.132.75.48   130.130.130.241 80000004 00000ace EXTR
0.0.0.0         278    130.132.88.112  130.130.130.241 80000004 0000f793 EXTR
0.0.0.0         279    130.132.81.208  130.130.130.241 80000004 000081b0 EXTR
0.0.0.0         284    130.132.46.224  130.130.130.241 80000004 000063e1 EXTR
0.0.0.0         285    130.132.40.64   140.140.140.243 80000004 0000ebff EXTR
0.0.0.0         286    130.132.33.160  150.150.150.245 80000004 0000751d EXTR
0.0.0.0         296    130.131.241.16  150.150.150.245 80000004 00002e25 EXTR
```

Syntax: show ip ospf database external-link-state [advertise <num>] | [link-state-id <ip-addr>] | [router-id <ip-addr>] | [sequence-number <num(Hex)>] | [status <num>]

The **advertise** <num> parameter displays the hexadecimal data in the specified LSA packet. The <num> parameter identifies the LSA packet by its position in the routing switch's External LSA table. To determine an LSA packet's position in the table, enter the **show ip ospf external-link-state** command to display the table. See "Displaying the Data in an LSA" on page 8-46 for an example.

The **link-state-id** <ip-addr> parameter displays the External LSAs for the LSA source specified by <IP-addr>.

The **router-id** <ip-addr> parameter shows the External LSAs for the specified OSPF router.

The **sequence-number** <num(Hex)> parameter displays the External LSA entries for the specified hexadecimal LSA sequence number.

This display shows the following information.

Table 8.5: CLI Display of OSPF External Link State Information

This Field...	Displays...
Area ID	The OSPF area the router is in.
Aging	The age of the LSA, in seconds.
LS ID	The ID of the link-state advertisement from which the routing switch learned this route.
Router	The router IP address.
Seq(hex)	The sequence number of the LSA. The OSPF neighbor that sent the LSA stamps it with a sequence number to enable the routing switch and other OSPF routers to determine which LSA for a given route is the most recent.
Chksum	A checksum for the LSA packet. The checksum is based on all the fields in the packet except the age field. The routing switch uses the checksum to verify that the packet is not corrupted.
Type	The route type, which is always EXTR (external).

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the <u>External Link State DB</u> link.

Displaying OSPF Link State Information

To display link state information for the routing switch, use one of the following methods.

USING THE CLI

To display link state information, enter the following command at any CLI level:

```
HP9300> show ip ospf database link-state
```

Syntax: show ip ospf database link-state [advertise <num>] | [link-state-id <ip-addr>] | [network] | [router] | [router-id <ip-addr>] | [sequence-number <num(Hex)>] | [status <num>] [summary]

The **advertise** <num> parameter displays the hexadecimal data in the specified LSA packet. The <num> parameter identifies the LSA packet by its position in the router's External LSA table. To determine an LSA packet's position in the table, enter the **show ip ospf external-link-state** command to display the table. See "Displaying the Data in an LSA" on page 8-46 for an example.

The **link-state-id** <ip-addr> parameter displays the External LSAs for the LSA source specified by <IP-addr>.

The **router-id** <ip-addr> parameter shows the External LSAs for the specified OSPF router.

The **sequence-number** <num(Hex)> parameter displays the External LSA entries for the specified hexadecimal LSA sequence number.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the <u>Link State DB</u> link.

Displaying the Data in an LSA

You can use the CLI to display the data the routing switch received in a specific External LSA packet or other type of LSA packet. For example, to display the LSA data in entry 3 in the External LSA table, enter the following command:

```
HP9300> show ip ospf database external-link-state advertise 3

05 84 02 05 82 83 0d 60 82 82 82 f1 80 00 00 02 e4 05
00 24 ff ff ff f0 80 00 00 0a 00 00 00 00 00 00 00 00
```

Syntax: show ip ospf database external-link-state [advertise <num>] | [link-state-id <ip-addr>] | [router-id <ip-addr>] | [sequence-number <num(Hex)>] | [status <num>]

To determine an external LSA's or other type of LSA's index number, enter one of the following commands to display the appropriate LSA table:

- **show ip ospf database link-state advertise** <num> – This command displays the data in the packet for the specified LSA.
- **show ip ospf database external-link-state advertise** <num> – This command displays the data in the packet for the specified external LSA.

For example, to determine an external LSA's index number, enter the following command:

```
HP9300> show ip ospf external-link-state

Index Aging  LS ID           Router          Seq(hex) Chksum
1     1332   130.132.81.208  130.130.130.241 80000002 000085ae
2     1325   130.132.116.192 130.130.130.241 80000002 0000a37d
3     1330   130.132.88.112  130.130.130.241 80000002 0000fb91
4     1333   130.132.75.48   130.130.130.241 80000002 00000ecc
5     1338   130.132.46.224  130.130.130.241 80000002 000067df
```

additional entries omitted for brevity...

USING THE WEB MANAGEMENT INTERFACE

You cannot display the contents of an LSA using the Web management interface.

Displaying OSPF Virtual Neighbor Information

To display OSPF virtual neighbor information for the routing switch, use one of the following methods.

USING THE CLI

To display OSPF virtual neighbor information, enter the following command at any CLI level:

```
HP9300> show ip ospf virtual-neighbor
```

Syntax: show ip ospf virtual-neighbor [<num>]

The <num> parameter displays the table beginning at the specified entry number.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the Virtual Neighbor link.

Displaying OSPF Virtual Link Information

To display OSPF virtual link information for the routing switch, use one of the following methods.

USING THE CLI

To display OSPF virtual link information, enter the following command at any CLI level:

```
HP9300> show ip ospf virtual-link
```

Syntax: show ip ospf virtual-link [<num>]

The <num> parameter displays the table beginning at the specified entry number.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the Virtual Interface link.

Displaying OSPF ABR and ASBR Information

To display OSPF ABR and ASBR information for the routing switch, use one of the following methods.

USING THE CLI

To display OSPF ABR and ASBR information, enter the following command at any CLI level:

```
HP9300> show ip ospf border-routers
```

Syntax: show ip ospf border-routers [<ip-addr>]

The <ip-addr> parameter displays the ABR and ASBR entries for the specified IP address.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the ABR ASBR Routers link.

Displaying OSPF Trap Status

To display the state (enabled or disabled) of the OSPF traps, use one of the following methods.

All traps are enabled by default when you enable OSPF. To disable or re-enable an OSPF trap, see “Modify OSPF Traps Generated” on page 8-35.

USING THE CLI

To display the state of each OSPF trap, enter the following command at any CLI level:

```
HP9300> show ip ospf trap

Interface State Change Trap:                      Enabled
Virtual Interface State Change Trap:              Enabled
Neighbor State Change Trap:                       Enabled
Virtual Neighbor State Change Trap:               Enabled
Interface Configuration Error Trap:               Enabled
Virtual Interface Configuration Error Trap:       Enabled
Interface Authentication Failure Trap:            Enabled
Virtual Interface Authentication Failure Trap:    Enabled
Interface Receive Bad Packet Trap:                Enabled
Virtual Interface Receive Bad Packet Trap:        Enabled
Interface Retransmit Packet Trap:                 Enabled
Virtual Interface Retransmit Packet Trap:         Enabled
Originate LSA Trap:                               Enabled
Originate MaxAge LSA Trap:                        Enabled
Link State Database Overflow Trap:                Enabled
Link State Database Approaching Overflow Trap:    Enabled
```

Syntax: show ip ospf trap

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to OSPF in the tree view to expand the list of OSPF option links.
4. Click on the Trap link to display the OSPF Trap panel.

Chapter 9
Configuring IP Multicast Protocols

This chapter describes how to configure HP routing switches for Protocol Independent Multicast (PIM) and Distance Vector Multicast Routing Protocol (DVMRP). HP routing switches support RFC 1075 for DVMRP and PIM Dense (PIM-DM). They also support RFC 2362 for PIM Sparse (PIM-SM).

NOTE: Each of the multicast protocols uses Internet Group Membership Protocol (IGMP). IGMP is automatically enabled on an interface when you configure PIM or DVMRP on an interface and is disabled on the interface if you disable PIM or DVMRP on the interface.

A summary of all CLI commands discussed in this chapter can also be found in the *Command Line Interface Reference*.

Overview of IP Multicasting

Multicast protocols allow a group or channel to be accessed over different networks by multiple stations (clients) for the receipt and transmit of multicast data.

Distribution of stock quotes, video transmissions such as news services and remote classrooms, and video conferencing are all examples of applications that use multicast routing.

HP routing switches support two different multicast routing protocols—Distance Vector Multicast Routing Protocol (DVMRP) and Protocol-Independent Multicast (PIM) protocol along with the Internet Group Membership Protocol (IGMP).

PIM and DVMRP are broadcast and pruning multicast protocols that deliver IP multicast datagrams. The protocols employ reverse path lookup check and pruning to allow source-specific multicast delivery trees to reach all group members. DVMRP and PIM build a different multicast tree for each source and destination host group.

NOTE: Both DVMRP and PIM can concurrently operate on different ports of an HP routing switch.

Multicast Terms

The following are commonly used terms in discussing multicast-capable routers. These terms are used throughout this chapter:

Node: Refers to a router or routing switch.

Root Node: The node that initiates the tree building process. It is also the router that sends the multicast packets down the multicast delivery tree.

Upstream: Represents the direction from which a router receives multicast data packets. An ***upstream router*** is a node that sends multicast packets.

Downstream: Represents the direction to which a router forwards multicast data packets. A ***downstream router*** is a node that receives multicast packets from upstream transmissions.

Group Presence: Means that a multicast group has been learned from one of the directly connected interfaces. Members of the multicast group are present on the router.

Intermediate nodes: Routers that are in the path between source routers and leaf routers.

Leaf nodes: Routers that do not have any downstream routers.

Multicast Tree: A unique tree is built for each source group (S,G) pair. A multicast tree is comprised of a root node and one or more nodes that are leaf or intermediate nodes.

Changing Global IP Multicast Parameters

The following configurable parameters apply to PIM-DM, PIM-SM, and DVMRP.

- Internet Group Membership Protocol (IGMP) parameters – You can change the query interval, group membership time, and maximum response time.
- Hardware forwarding of fragmented IP multicast packets – You can enable the routing switch to forward all fragments of fragmented IP multicast packets in hardware.

Changing IGMP Parameters

IGMP allows HP routing switches to limit the multicast of IGMP packets to only those ports on the routing switch that are identified as IP Multicast members. HP devices support IGMP versions 1 and 2.

The routing switch actively sends out host queries to identify IP Multicast groups on the network, inserts the group information in an IGMP packet, and forwards the packet to IP Multicast neighbors.

The following parameters apply to PIM and DVMRP:

- IGMP query interval – Specifies how often the routing switch queries an interface for group membership. Possible values are 1 – 3600. The default is 60.
- IGMP group membership time – Specifies how many seconds an IP Multicast group can remain on a routing switch interface in the absence of a group report. Possible values are 1 – 7200. The default is 60.
- IGMP maximum response time – Specifies how many seconds the routing switch will wait for an IGMP response from an interface before concluding that the group member on that interface is down and removing the interface from the group. Possible values are 1 – 10. The default is 10.

To change these parameters, you must first enter the following CLI command at the global CLI level:

```
HP9300(config)# ip multicast-routing
```

Syntax: [no] ip multicast-routing

NOTE: You must enter the **ip multicast-routing** command before changing the global IP Multicast parameters. Otherwise, the changes do not take effect and the software uses the default values.

Modifying IGMP Query Interval Period

The IGMP query interval period defines how often a routing switch will query an interface for group membership. Possible values are 1 – 3,600 seconds and the default value is 60 seconds.

USING THE CLI

To modify the default value for the IGMP query interval, enter the following:

```
HP9300(config)# ip igmp query 120
```

Syntax: ip igmp query-interval <1-3600>

USING THE WEB MANAGEMENT INTERFACE

To modify the default value for the IGMP query interval:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the configuration options.
3. Click on the plus sign next to DVMRP in the tree view to display the DVMRP configuration options.
4. Select the IGMP link to display the IGMP configuration panel.
5. Enter a value from 1 – 3600 in the Query Interval field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying IGMP Membership Time

Group membership time defines how long a group will remain active on an interface in the absence of a group report. Possible values are from 1 – 7200 seconds and the default value is 140 seconds.

USING THE CLI

To define an IGMP membership time of 240 seconds, enter the following:

```
HP9300(config)# ip igmp group-membership-time 240
```

Syntax: ip igmp group-membership-time <1-7200>

USING THE WEB MANAGEMENT INTERFACE

To modify the default value for the IGMP membership time, you would do the following:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the configuration options.
3. Click on the plus sign next to DVMRP in the tree view to display the DVMRP configuration options.
4. Select the IGMP link to display the IGMP configuration panel.
5. Enter a value from 1 – 7200 in the Group Membership Time field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying IGMP Maximum Response Time

Maximum response time defines how long the routing switch will wait for an IGMP response from an interface before concluding that the group member on that interface is down and removing the interface from the group. Possible values are 1 – 10. The default is 10.

USING THE CLI

To change the maximum response time to 5 seconds, enter the following:

```
HP9300(config)# ip igmp max-response-time 5
```

Syntax: ip igmp max-response-time <1-10>

USING THE WEB MANAGEMENT INTERFACE

You cannot change this parameter using the Web management interface.

Enabling Hardware Forwarding for all Fragments of IP Multicast Packets

By default, an HP routing switch forwards the first fragment of a fragmented IP multicast packet through hardware, but forwards the remaining fragments through the software. You can enable the device to forward all the fragments of fragmented IP multicast packet through hardware.

NOTE: This feature applies only to routing switches, not to switches.

To enable hardware forwarding of all the IP multicast fragments, use the following CLI method.

USING THE CLI

To enable hardware forwarding of all IP multicast fragments, enter the following command at the global CONFIG level of the CLI:

```
HP9300(config)# ip multicast-perf
```

Syntax: [no] ip multicast-perf

USING THE WEB MANAGEMENT INTERFACE

You cannot configure this feature using the Web management interface.

PIM Dense Overview

NOTE: This section describes the “dense” mode of PIM, described in RFC 1075. See “PIM Sparse Overview” on page 9-12 for information about PIM Sparse.

PIM was introduced to simplify some of the complexity of the routing protocol at the cost of additional overhead tied with a greater replication of forwarded multicast packets. PIM is similar to DVMRP in that PIM builds source-routed multicast delivery trees and employs reverse path check when forwarding multicast packets.

There are two modes in which PIM operates: Dense and Sparse. The Dense Mode is suitable for densely populated multicast groups, primarily in the LAN environment. The Sparse Mode is suitable for sparsely populated multicast groups with the focus on WAN.

PIM primarily differs from DVMRP by using the IP routing table instead of maintaining its own, thereby being routing protocol independent.

Initiating PIM Multicasts on a Network

Once PIM is enabled on each router, a network user can begin a video conference multicast from the server on R1. When a multicast packet is received on a PIM-capable router interface, the interface checks its IP routing table to determine whether the interface that received the message provides the shortest path back to the source. If the interface does provide the shortest path back to the source, the multicast packet is then forwarded to all neighboring PIM routers. Otherwise, the multicast packet is discarded and a prune message is sent back upstream.

In Figure 9.1, the root node (R1) is forwarding multicast packets for group 229.225.0.1, which it receives from the server, to its downstream nodes, R2, R3, and R4. Router R4 is an intermediate router with R5 and R6 as its downstream routers. Because R5 and R6 have no downstream interfaces, they are leaf nodes. The receivers in this example are those workstations that are resident on routers R2, R3, and R6.

Pruning a Multicast Tree

As multicast packets reach these leaf routers, the routers check their IGMP databases for the group. If the group is not in a router’s IGMP database, the router discards the packet and sends a prune message to the upstream router. The router that discarded the packet also maintains the prune state for the source, group (S,G) pair. The branch is then pruned (removed) from the multicast tree. No further multicast packets for that specific (S,G) pair will be received from that upstream router until the prune state expires. You can configure the PIM Prune Timer (the length of time that a prune state is considered valid).

For example, in Figure 9.1 the sender with address 207.95.5.1 is sending multicast packets to the group 229.225.0.1. If a PIM router receives any groups other than that group, the router discards the group and sends a prune message to the upstream PIM router.

In Figure 9.2, Router R5 is a leaf node with no group members in its IGMP database. Therefore, the router must be pruned from the multicast tree. R5 sends a prune message upstream to its neighbor router R4 to remove itself from the multicast delivery tree and install a prune state, as seen in Figure 9.2. Router 5 will not receive any further multicast traffic until the prune age interval expires.

When a node on the multicast delivery tree has all of its downstream branches (downstream interfaces) in the prune state, a prune message is sent upstream. In the case of R4, if both R5 and R6 are in a prune state at the same time, R4 becomes a leaf node with no downstream interfaces and sends a prune message to R1. With R4 in a prune state, the resulting multicast delivery tree would consist only of leaf nodes R2 and R3.

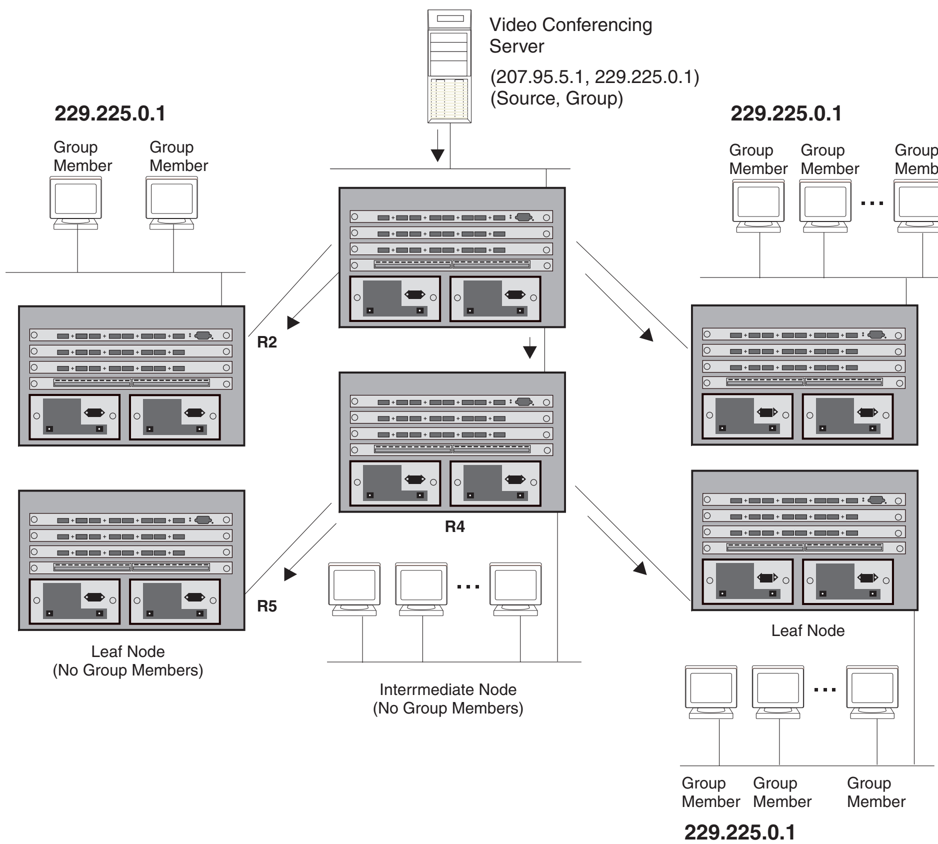


Figure 9.1 Transmission of multicast packets from the source to host group members

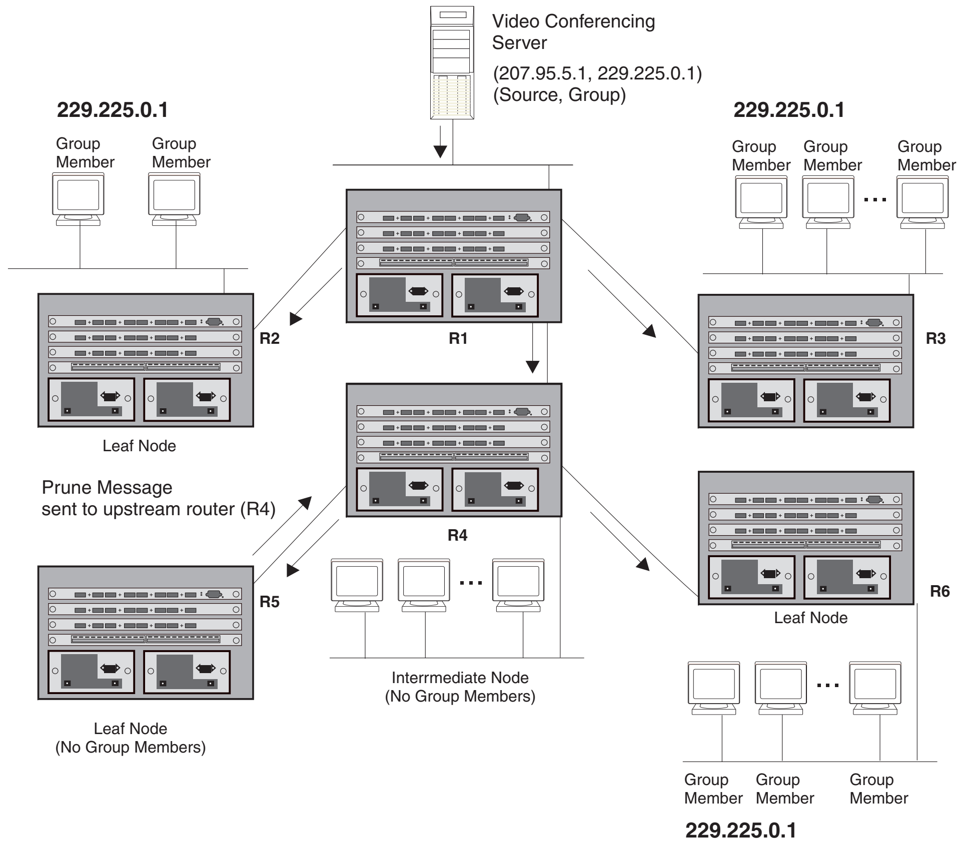


Figure 9.2 Pruning leaf nodes from a multicast tree

Grafts to a Multicast Tree

A PIM router restores pruned branches to a multicast tree by sending graft messages towards the upstream router. Graft messages start at the leaf node and travel up the tree, first sending the message to its neighbor upstream router.

In the example above, if a new 229.255.0.1 group member joins on router R6, which was previously pruned, a graft is sent upstream to R4. Since the forwarding state for this entry is in a prune state, R4 sends a graft to R1. Once R4 has joined the tree, R4 along with R6 once again receive multicast packets.

Prune and graft messages are continuously used to maintain the multicast delivery tree. No configuration is required on your part.

Configuring PIM

NOTE: This section describes how to configure the “dense” mode of PIM, described in RFC 1075. See “Configuring PIM Sparse” on page 9-13 for information about configuring PIM Sparse.

Enabling PIM on the Routing Switch and an Interface

By default, PIM is disabled. To enable PIM:

- Enable the feature globally.
- Configure the IP interfaces that will use PIM.
- Enable PIM locally on the ports that contain the IP interfaces you are using for PIM.
- Reload the software to place PIM into effect.

EXAMPLE:

Suppose you want to initiate the use of desktop video for fellow users on a sprawling campus network. All destination workstations have the appropriate hardware and software but the HP routing switches that connect the various buildings need to be configured to support PIM multicasts from the designated video conference server as shown in Figure 9.1 on page 9-5.

PIM is enabled on each of the HP routing switches shown in Figure 9.1, on which multicasts are expected. You can enable PIM on each routing switch independently or remotely from one of the routing switches with a Telnet connection. Follow the same steps for each routing switch. A reset of the routing switch is required when PIM is first enabled. Thereafter, all changes are dynamic.

USING THE CLI

EXAMPLE:

To enable PIM on router1 and interface 3, enter the following:

```
Router1(config)# router pim
Router1(config-pim-router)# int e 3
Router1(config-if-3)# ip address 207.95.5.1/24
Router1(config-if-3)# ip pim
Router1(config-if-3)# write memory
Router1(config-if-3)# end
Router1# reload
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled PIM, enable it by clicking on the Enable radio button next to PIM on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
5. Click on the Virtual Interface link to display the PIM Interface configuration panel.

NOTE: If the device already has PIM interfaces, a table listing the interfaces is displayed. Click the Modify button to the right of the row describing an interface to change its configuration, or click the Add Virtual Interface link to display the PIM Interface configuration panel.

6. Select the interface type. You can select Subnet or Tunnel.
7. Select the IP address of the interface being configured from the Local Address pulldown menu.

8. If you are configuring an IP Tunnel, enter the IP address of the destination interface, the end point of the IP Tunnel, in the Remote Address field. IP tunneling must also be enabled and defined on the destination router interface as well.

NOTE: The Remote Address field applies only to tunnel interfaces, not to sub-net interfaces.

9. Modify the time to live threshold (TTL) if necessary. The TTL defines the minimum value required in a packet in order for the packet to be forwarded out the interface.

NOTE: For example, if the TTL for an interface is set at 10, it means that only those packets with a TTL value of 10 or more will be forwarded. Likewise, if an interface is configured with a TTL Threshold value of 1, all packets received on that interface will be forwarded. Possible values are 1 – 64. The default value is 1.

10. Click the Add button to save the change to the device's running-config file.
11. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.
12. Click on the plus sign next to Command in the tree view to list the command options.
13. Select the Reload link and select Yes when prompted to reload the software. You must reload after enabling PIM to place the change into effect. If PIM was already enabled when you added the interface, you do not need to reload.

Modifying PIM Global Parameters

PIM global parameters come with preset values. The defaults work well in most networks, but you can modify the following parameters if you need to:

- Neighbor timeout
- Hello timer
- Prune timer
- Graft retransmit timer
- Inactivity timer

Modifying Neighbor Timeout

Neighbor timeout is the interval after which a PIM routing switch will consider a neighbor to be absent. Absence of PIM hello messages from a neighboring router indicates that a neighbor is not present.

The default value is 180 seconds.

USING THE CLI

To apply a PIM neighbor timeout value of 360 seconds to all ports on the routing switch operating with PIM, enter the following:

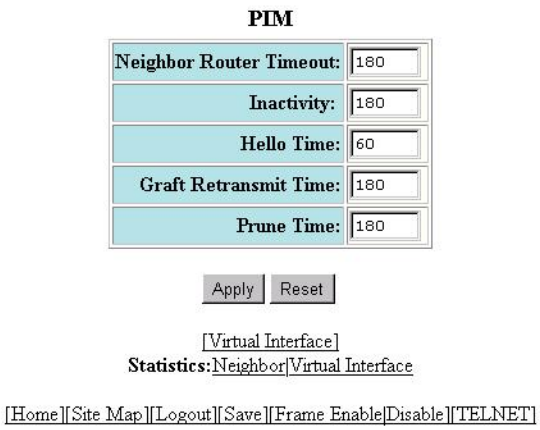
```
HP9300(config)# router pim
HP9300(config-pim-router)# nbr-timeout 360
```

Syntax: nbr-timeout <60-8000>

The default is 180 seconds.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
4. Click on the General link to display the PIM configuration panel, as shown in the following example.



5. Enter a value from 10 – 3600 into the Neighbor Router Timeout field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Hello Timer

This parameter defines the interval at which periodic hellos are sent out PIM interfaces. Routers use hello messages to inform neighboring routers of their presence. The default rate is 60 seconds.

USING THE CLI

To apply a PIM hello timer of 120 seconds to all ports on the routing switch operating with PIM, enter the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# hello-timer 120
```

Syntax: hello-timer <10-3600>

The default is 60 seconds.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled PIM, enable it by clicking on the Enable radio button next to PIM on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
5. Click on the General link to display the PIM configuration panel
6. Enter a value from 10 – 3600 into the Prune Time field.
7. Click the Apply button to save the change to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Prune Timer

This parameter defines how long an HP PIM routing switch will maintain a prune state for a forwarding entry.

The first received multicast interface is forwarded to all other PIM interfaces on the routing switch. If there is no presence of groups on that interface, the leaf node sends a prune message upstream and stores a prune state. This prune state travels up the tree and installs a prune state.

A prune state is maintained until the prune timer expires or a graft message is received for the forwarding entry. The default value is 180 seconds.

USING THE CLI

To set the PIM prune timer to 90, enter the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# prune-timer 90
```

Syntax: prune-timer <10-3600>

The default is 180 seconds.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled PIM, enable it by clicking on the Enable radio button next to PIM on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
5. Click on the General link to display the PIM configuration panel
6. Enter a value from 10 – 3600 in the Hello Time field.
7. Click the Apply button to save the change to the device’s running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Modifying Graft Retransmit Timer

The Graft Retransmit Timer defines the interval between the transmission of graft messages.

A graft message is sent by a router to cancel a prune state. When a router receives a graft message, the router responds with a Graft Ack (acknowledge) message. If this Graft Ack message is lost, the router that sent the graft message will resend it.

USING THE CLI

To change the graft retransmit timer from the default of 180 to 90 seconds, enter the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# graft-retransmit-timer 90
```

Syntax: graft-retransmit-timer <10-3600>

The default is 180 seconds.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled PIM, enable it by clicking on the Enable radio button next to PIM on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
5. Click on the General link to display the PIM configuration panel
6. Enter a value from 10 – 3600 into the Graft Retransmit Time field.
7. Click the Apply button to save the change to the device’s running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Modifying Inactivity Timer

The routing switch deletes a forwarding entry if the entry is not used to send multicast packets. The PIM inactivity timer defines how long a forwarding entry can remain unused before the routing switch deletes it.

USING THE CLI

To apply a PIM inactivity timer of 90 seconds to all PIM interfaces, enter the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# inactivity-timer 90
```

Syntax: inactivity-timer <10-3600>

The default is 180 seconds.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled PIM, enable it by clicking on the Enable radio button next to PIM on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
5. Click on the General link to display the PIM configuration panel
6. Enter a value from 10 – 3600 into the Inactivity field.
7. Click the Apply button to save the change to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying PIM Interface Parameters

TTL is the only interface parameter for PIM. TTL defines the minimum value required in a packet for it to be forwarded out of the interface.

For example, if the TTL for an interface is set at 10, it means that only those packets with a TTL value of 10 or more will be forwarded. Likewise, if an interface is configured with a TTL Threshold value of 1, all packets received on that interface will be forwarded. Possible TTL values are 1 to 64. The default TTL value is 1.

USING THE CLI

To configure a TTL of 45, enter the following:

```
HP9300(config-if-3/24)# ip pim ttl 45
```

Syntax: ip pim ttl <1-64>

USING THE WEB MANAGEMENT INTERFACE

To modify the PIM parameter (TTL) for an interface:

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
4. Select the Virtual Interface link to display a table listing the configured PIM Interfaces.
5. Click on the Modify button next to the interface you want to modify. The PIM Interface configuration panel is displayed.
6. Modify the parameters as needed.
7. Click the Add button to save the changes to the device's running-config file.

8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

PIM Sparse Overview

Software release 06.6.*X* adds support for Protocol Independent Multicast (PIM) Sparse version 2. PIM Sparse provides multicasting that is especially suitable for widely distributed multicast environments. The HP implementation is based on RFC 2362.

In a PIM Sparse network, a PIM Sparse router that is connected to a host that wants to receive information for a multicast group must explicitly send a join request on behalf of the receiver (host).

PIM Sparse routers are organized into domains. A PIM Sparse domain is a contiguous set of routers that all implement PIM and are configured to operate within a common boundary. Figure 9.3 shows a simple example of a PIM Sparse domain. This example shows three HP 9304M or HP 9308M routing switches configured as PIM Sparse routers. The configuration is described in detail following the figure.

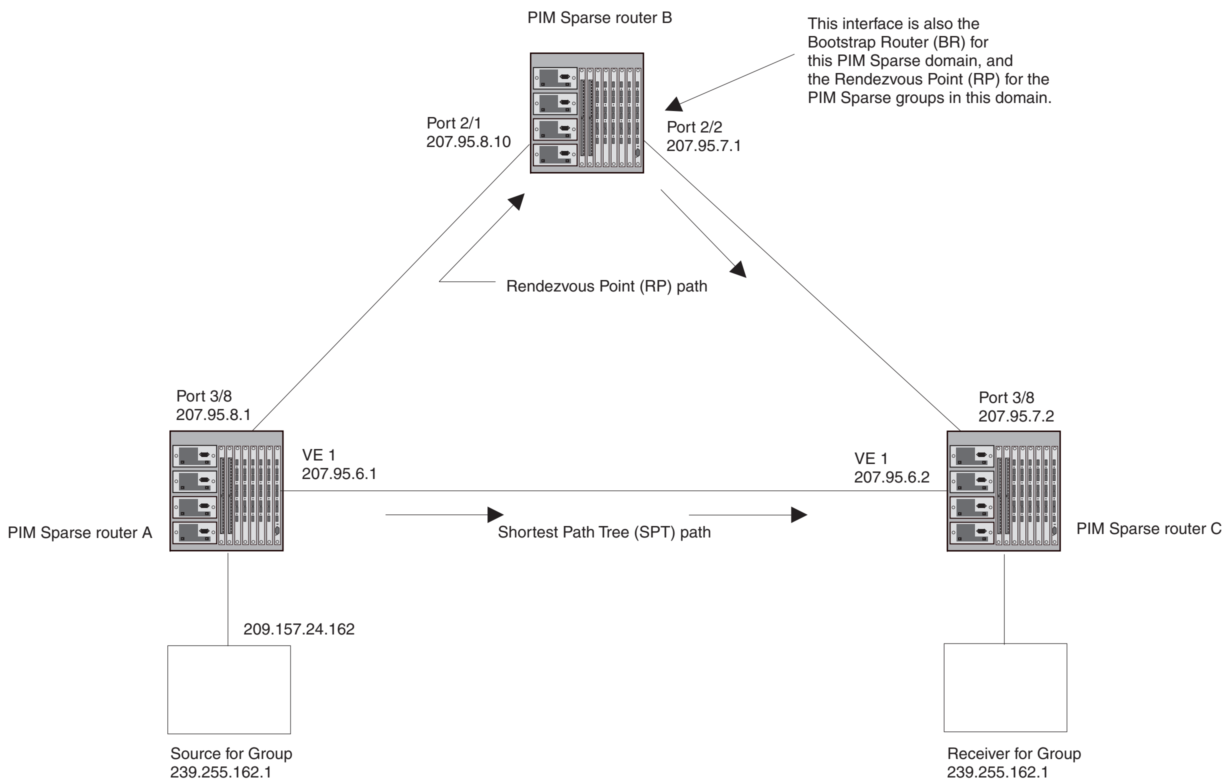


Figure 9.3 Example PIM Sparse domain

PIM Sparse Router Types

Routers that are configured with PIM Sparse interfaces also can be configured to fill one or more of the following roles:

- PMBR – A PIM router that has some interfaces within the PIM domain and other interface outside the PIM domain. PBMRs connect the PIM domain to the Internet.

NOTE: You cannot configure an HP routing interface as a PMBR interface for PIM Sparse in the current software release.

- BSR – The Bootstrap Router (BSR) distributes RP information to the other PIM Sparse routers within the domain. Each PIM Sparse domain has one active BSR. For redundancy, you can configure ports on multiple routers as candidate BSRs. The PIM Sparse protocol uses an election process to select one of the candidate BSRs as the BSR for the domain. The BSR with the highest BSR priority (a user-configurable parameter) is elected. If the priorities result in a tie, then the candidate BSR interface with the highest IP address is elected. In the example in Figure 9.3, PIM Sparse router B is the BSR. Port 2/2 is configured as a candidate BSR.
- RP – The RP is the meeting point for PIM Sparse sources and receivers. A PIM Sparse domain can have multiple RPs, but each PIM Sparse multicast group address can have only one active RP. PIM Sparse routers learn the addresses of RPs and the groups for which they are responsible from messages that the BSR sends to each of the PIM Sparse routers. In the example in Figure 9.3, PIM Sparse router B is the RP. Port 2/2 is configured as a candidate Rendezvous Point (RP).

  To enhance overall network performance, HP routing switches use the RP to forward only the first packet from a group source to the group's receivers. After the first packet, the routing switch calculates the shortest path between the receiver and source (the Shortest Path Tree, or SPT) and uses the SPT for subsequent packets from the source to the receiver. The routing switch calculates a separate SPT for each source-receiver pair.

NOTE: Hewlett-Packard recommends that you configure the same ports as candidate BSRs and RPs.

RP Paths and SPT Paths

Figure 9.3 shows two paths for packets from the source for group 239.255.162.1 and a receiver for the group. The source is attached to PIM Sparse router A and the recipient is attached to PIM Sparse router C. PIM Sparse router B in is the RP for this multicast group. As a result, the default path for packets from the source to the receiver is through the RP. However, the path through the RP sometimes is not the shortest path. In this case, the shortest path between the source and the receiver is over the direct link between router A and router C, which bypasses the RP (router B).

To optimize PIM traffic, the protocol contains a mechanism for calculating the Shortest Path Tree (SPT) between a given source and receiver. PIM Sparse routers can use the SPT as an alternative to using the RP for forwarding traffic from a source to a receiver. By default, HP routing switches forward the first packet they receive from a given source to a given receiver using the RP path, but forward subsequent packets from that source to that receiver through the SPT. In Figure 9.3, routing switch A forwards the first packet from group 239.155.162.1's source to the destination by sending the packet to router B, which is the RP. Router B then sends the packet to router C. For the second and all future packets that router A receives from the source for the receiver, router A forwards them directly to router C using the SPT path.

Configuring PIM Sparse

Limitations in this Release

The implementation of PIM Sparse in the current software release has the following limitations:

- PIM Border Routers (PMBRs) are not supported. Thus, you cannot configure an HP routing interface as a PMBR interface for PIM Sparse.
- PIM Sparse and regular PIM (dense mode) cannot be used on the same interface.
- You cannot configure or display PIM Sparse information using the Web management interface. (You can display some general PIM information, but not specific PIM Sparse information.)

To configure an HP routing switch for PIM Sparse, perform the following tasks:

- Configure the following global parameters:
  - Enable the PIM Sparse mode of multicast routing.
  - If you have not already done so, enable a unicast routing protocol (RIP or OSPF).

- Configure the following interface parameters:
  - Configure an IP address on the interface
  - Enable PIM Sparse.
  - Identify the interface as a PIM Sparse border, if applicable.

NOTE: You cannot configure an HP routing interface as a PMBR interface for PIM Sparse in the current software release.

- Configure the following IPM Sparse global parameters:
  - Identify the routing switch as a candidate PIM Sparse Bootstrap Router (BSR), if applicable.
  - Identify the routing switch as a candidate PIM Sparse Rendezvous Point (RP), if applicable.
  - Specify the IP address of the RP (if you want to statically select the RP).

NOTE: Hewlett-Packard recommends that you configure the same routing switch as both the BSR and the RP.

Configuring Global Parameters

To configure the PIM Sparse global parameters, use either of the following methods.

USING THE CLI

To configure basic global PIM Sparse parameters, enter commands such as the following on each routing switch within the PIM Sparse domain:

```
HP9300(config)# router pim
HP9300(config-pim-router)# router rip
HP9300(config-rip-router)#
```

Syntax: [no] router pim

Syntax: [no] router rip

NOTE: You do not need to globally enable IP multicast routing when configuring PIM Sparse.

The commands in this example enable IP multicast routing, enable the PIM Sparse mode of IP multicast routing, and then enable RIP. For simplicity, this example does not show configuration of specific RIP parameters. In addition, the commands in this example do not configure the routing switch as a candidate PIM Sparse Bootstrap Router (BSR) and candidate Rendezvous Point (RP). You can configure an HP routing switch as a PIM Sparse router without configuring the routing switch as a candidate BSR and RP. However, if you do configure the routing switch as one of these, Hewlett-Packard recommends that you configure the routing switch as both of these. See “Configuring PIM Sparse Global Parameters” on page 9-15.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure PIM Sparse parameters using the Web management interface.

Configuring PIM Interface Parameters

After you enable IP multicast routing and PIM Sparse at the global level, you must enable it on the individual interfaces connected to the PIM Sparse network. To do so, use the following CLI method.

USING THE CLI

To enable PIM Sparse mode on an interface, enter commands such as the following:

```
HP9300(config)# interface ethernet 2/2
HP9300(config-if-2/2)# ip address 207.95.7.1 255.255.255.0
HP9300(config-if-2/2)# ip pim-sparse
```

Syntax: [no] ip pim-sparse

The commands in this example add an IP interface to port 2/2, then enable PIM Sparse on the interface.

If the interface is on the border of the PIM Sparse domain, you also must enter the following command:

```
HP9300(config-if-2/2)# ip pim border
```

Syntax: [no] ip pim border

NOTE: You cannot configure an HP routing interface as a PMBR interface for PIM Sparse in the current software release.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure PIM Sparse parameters using the Web management interface.

Configuring PIM Sparse Global Parameters

In addition to the global and interface parameters in the sections above, you need to identify an interface on at least one routing switch as a candidate PIM Sparse Bootstrap router (BSR) and candidate PIM Sparse Rendezvous Point (RP).

NOTE: It is possible to configure the routing switch as only a candidate BSR or RP, but Hewlett-Packard recommends that you configure the same interface on the same routing switch as both a BSR and an RP.

To configure the routing switch as a candidate BSR and RP, use the following CLI method.

USING THE CLI

To configure the routing switch as a candidate BSR, enter commands such as the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# bsr-candidate ethernet 2/2 30 255
BSR address: 207.95.7.1, hash mask length: 30, priority: 255
```

This command configures the PIM Sparse interface on port 2/2 as a BSR candidate, with a hash mask length of 30 and a priority of 255. The information shown in italics above is displayed by the CLI after you enter the candidate BSR configuration command.

Syntax: [no] router pim

Syntax: [no] bsr-candidate ethernet | ve <portnum> | <num> <hash-mask-length> [<priority>]

The **ethernet | ve** <portnum> | <num> parameter specifies the interface. Enter **ethernet** <portnum> for a physical interface (port). Enter **ve** <num> for a virtual interface. The routing switch will advertise the specified interface's IP address as a candidate BSR.

The <hash-mask-length> parameter specifies the number of bits in a group address that are significant when calculating the group-to-RP mapping. You can specify a value from 1 – 32.

NOTE: Hewlett-Packard recommends you specify 30 for IP version 4 (IPv4) networks.

The <priority> specifies the BSR priority. You can specify a value from 0 – 255. When the election process for BSR takes place, the candidate BSR with the highest priority becomes the BSR. The default is 0.

Enter a command such as the following to configure the routing switch as a candidate RP:

```
HP9300(config-pim-router)# rp-candidate ethernet 2/2
```

Syntax: [no] rp-candidate ethernet | ve <portnum> | <num>

The **ethernet | ve** <portnum> | <num> parameter specifies the interface. Enter **ethernet** <portnum> for a physical interface (port). Enter **ve** <num> for a virtual interface. The routing switch will advertise the specified interface's IP address as a candidate RP.

By default, this command configures the routing switch as a candidate RP for all group numbers beginning with 224. As a result, the routing switch is a candidate RP for all valid PIM Sparse group numbers. You can change this by adding or deleting specific address ranges. The following example narrows the group number range for which the routing switch is a candidate RP by explicitly adding a range.

```
HP9300(config-pim-router)# rp-candidate add 224.126.0.0 16
```

Syntax: [no] rp-candidate add <group-addr> <mask-bits>

The <group-addr> <mask-bits> specifies the group address and the number of significant bits in the sub-net mask. In this example, the routing switch is a candidate RP for all groups that begin with 224.126. When you add a range, you override the default. The routing switch then becomes a candidate RP only for the group address range(s) you add.

You also can change the group numbers for which the routing switch is a candidate RP by deleting address ranges. For example, to delete all addresses from 224.126.22.0 – 224.126.22.255, enter the following command:

```
HP9300(config-pim-router)# rp-candidate delete 224.126.22.0 24
```

Syntax: [no] rp-candidate delete <group-addr> <mask-bits>

The usage of the <group-addr> <mask-bits> parameter is the same as for the **rp-candidate add** command.

If you enter both commands shown in the example above, the net effect is that the routing switch becomes a candidate RP for groups 224.126.0.0 – 224.126.21.255 and groups 224.126.23.0 – 224.126.255.255.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure PIM Sparse parameters using the Web management interface.

Statically Specifying the RP

Hewlett-Packard recommends that you use the PIM Sparse protocol's RP election process so that a backup RP can automatically take over if the active RP router becomes unavailable. However, if you do not want the RP to be selected by the RP election process but instead you want to explicitly identify the RP by its IP address, you can do using the following CLI method.

If you explicitly specify the RP, the routing switch uses the specified RP for all group-to-RP mappings and overrides the set of candidate RPs supplied by the BSR.

NOTE: Specify the same IP address as the RP on all PIM Sparse routers within the PIM Sparse domain. Make sure the router is on the backbone or is otherwise well connected to the rest of the network.

USING THE CLI

To specify the IP address of the RP, enter commands such as the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# rp-address 207.95.7.1
```

Syntax: [no] rp-address <ip-addr>

The <ip-addr> parameter specifies the IP address of the RP.

The command in the example above identifies the router interface at IP address 207.95.7.1 as the RP for the PIM Sparse domain. The routing switch will use the specified RP and ignore group-to-RP mappings received from the BSR.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure PIM Sparse parameters using the Web management interface.

Changing the Shortest Path Tree (SPT) Threshold

In a typical PIM Sparse domain, there may be two or more paths from a DR (designated router) for a multicast source to a PIM group receiver.

- Path through the RP – This is the path the routing switch uses the first time it receives traffic for a PIM group. However, the path through the RP may not be the shortest path from the routing switch to the receiver.
- Shortest Path – Each PIM Sparse router that is a DR for a multicast source calculates a shortest path tree (SPT) to all the PIM Sparse group receivers within the domain, with the routing switch itself as the root of the tree. The first time an HP routing switch configured as a PIM router receives a packet for a PIM receiver, the routing switch sends the packet to the RP for the group. The routing switch also calculates the SPT from itself to the receiver. The next time the routing switch receives a PIM Sparse packet for the receiver, the routing switch sends the packet toward the receiver using the shortest route, which may not pass through the RP.

By default, the device switches from the RP to the SPT after receiving the first packet for a given PIM Sparse group. The routing switch maintains a separate counter for each PIM Sparse source-group pair.

After the routing switch receives a packet for a given source-group pair, the routing switch starts a PIM data timer for that source-group pair. If the routing switch does not receive another packet for the source-group pair before the timer expires, it reverts to using the RP for the next packet received for the source-group pair. In accordance with the PIM Sparse RFC's recommendation, the timer is 210 seconds and is not configurable. The counter is reset to zero each time the routing switch receives a packet for the source-group pair.

You can change the number of packets that the routing switch sends using the RP before switching to using the SPT. To do so, use the following CLI method.

USING THE CLI

To change the number of packets the routing switch sends using the RP before switching to the SPT, enter commands such as the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# spt-threshold 1000
```

Syntax: [no] spt-threshold infinity | <num>

The **infinity** | <num> parameter specifies the number of packets. If you specify **infinity**, the routing switch sends packets using the RP indefinitely and does not switch over to the SPT. If you enter a specific number of packets, the routing switch does not switch over to using the SPT until it has sent the number of packets you specify using the RP.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure PIM Sparse parameters using the Web management interface.

Changing the PIM Join and Prune Message Interval

By default, the routing switch sends PIM Sparse Join/Prune messages every 60 seconds. These messages inform other PIM Sparse routers about clients who want to become receivers (Join) or stop being receivers (Prune) for PIM Sparse groups.

You can change the Join/Prune message interval using the following CLI method.

NOTE: Use the same Join/Prune message interval on all the PIM Sparse routers in the PIM Sparse domain. If the routers do not all use the same timer interval, the performance of PIM Sparse can be adversely affected.

USING THE CLI

To change the Join/Prune interval, enter commands such as the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# message-interval 30
```

Syntax: [no] message-interval <num>

The <num> parameter specifies the number of seconds and can from 1 – 65535. The default is 60.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure PIM Sparse parameters using the Web management interface.

Displaying PIM Sparse Configuration Information and Statistics

You can display the following PIM Sparse information:

- Basic PIM Sparse configuration information
- Group information
- BSR information
- Candidate RP information
- RP-to-group mappings
- RP information for a PIM Sparse group
- RP set list
- PIM Neighbor information
- The PIM flow cache
- The PIM multicast cache
- PIM traffic statistics

Displaying Basic PIM Sparse Configuration Information

To display basic configuration information for PIM Sparse, use the following CLI method.

USING THE CLI

To display PIM Sparse configuration information, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim sparse

Global PIM Sparse Mode Settings
  Hello interval: 60, Neighbor timeout: 180
  Bootstrap Msg interval: 130, Candidate-RP Advertisement interval: 60
  Join/Prune interval: 60, SPT Threshold: 1

Interface Ethernet e3/8
TTL Threshold: 1, Enabled
Local Address: 207.95.8.1

Interface Ve 1
TTL Threshold: 1, Enabled
Local Address: 207.95.6.1
```

Syntax: show ip pim sparse

This example shows the PIM Sparse configuration information on PIM Sparse router A in Figure 9.3.

This display shows the following information.

This Field...	Displays...
Global PIM Sparse mode settings	
Hello interval	How frequently the routing switch sends PIM Sparse hello messages to its PIM Sparse neighbors. This field show the number of seconds between hello messages. PIM Sparse routers use hello messages to discover one another.
Neighbor timeout	How many seconds the routing switch will wait for a hello message from a neighbor before determining that the neighbor is no longer present and removing cached PIM Sparse forwarding entries for the neighbor.
Bootstrap Msg interval	How frequently the BSR configured on the routing switch sends the RP set to the RPs within the PIM Sparse domain. The RP set is a list of candidate RPs and their group prefixes. A candidate RP's group prefix indicates the range of PIM Sparse group numbers for which it can be an RP. **Note**: This field contains a value only if an interface on the routing switch is elected to be the BSR. Otherwise, the field is blank.
Candidate-RP Advertisement interval	How frequently the candidate PR configured on the routing switch sends candidate RP advertisement messages to the BSR. **Note**: This field contains a value only if an interface on the routing switch is configured as a candidate RP. Otherwise, the field is blank.
Join/Prune interval	How frequently the routing switch sends PIM Sparse Join/Prune messages for the multicast groups it is forwarding. This field show the number of seconds between Join/Prune messages. The routing switch sends Join/Prune messages on behalf of multicast receivers who want to join or leave a PIM Sparse group. When forwarding packets from PIM Sparse sources, the routing switch sends the packets only on the interfaces on which it has received join requests in Join/Prune messages for the source's group. You can change the Join/Prune interval if needed. See "Changing the PIM Join and Prune Message Interval" on page 9-17.
SPT Threshold	The number of packets the routing switch sends using the path through the RP before switching to using the SPT path.
PIM Sparse interface information **Note**: You also can display IP multicast interface information using the **show ip pim interface** command. However, this command lists all IP multicast interfaces, including regular PIM (dense mode) and DVMRP interfaces. The **show ip pim sparse** command lists only the PIM Sparse interfaces.	
Interface	The type of interface and the interface number. The interface type can be one of the following: • Ethernet • VE The number is either a port number (and slot number if applicable) or the virtual interface (VE) number.

This Field...	Displays...
TTL Threshold	Following the TTL threshold value, the interface state is listed. The interface state can be one of the following: • Disabled • Enabled
Local Address	Indicates the IP address configured on the port or virtual interface.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying a List of Multicast Groups

To display a list of the IP multicast groups the routing switch is forwarding, use the following CLI method.

USING THE CLI

To display PIM Sparse configuration information, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim group

Total number of Groups: 2
Index 1         Group 239.255.162.1       Ports e3/11
```

Syntax: show ip pim group

This display shows the following information.

This Field...	Displays...
Total number of Groups	Lists the total number of IP multicast groups the routing switch is forwarding. **Note**: This list can include groups that are not PIM Sparse groups. If interfaces on the routing switch are configured for regular PIM (dense mode) or DVMRP, these groups are listed too.
Index	The index number of the table entry in the display.
Group	The multicast group address
Ports	The routing switch ports connected to the receivers of the groups.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying BSR Information

To display information about the BSR, use the following CLI method.

USING THE CLI

To display BSR information, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim bsr

PIMv2 Bootstrap information

This system is the elected Bootstrap Router (BSR)
  BSR address: 207.95.7.1
  Uptime: 00:33:52, BSR priority: 5, Hash mask length: 32
```

```
  Next bootstrap message in 00:00:20

Next Candidate-RP-advertisement in 00:00:10
  RP: 207.95.7.1
    group prefixes:
    224.0.0.0 / 4
Candidate-RP-advertisement period: 60
```

This example show information displayed on a routing switch that has been elected as the BSR. The following example shows information displayed on a routing switch that is not the BSR. Notice that some fields shown in the example above do not appear in the example below.

```
HP9300(config-pim-router)# show ip pim bsr

PIMv2 Bootstrap information
 local BSR address  = 207.95.7.1
 local BSR priority = 5
```

Syntax: show ip pim bsr

This display shows the following information.

This Field...	Displays...
BSR address or local BSR address	The IP address of the interface configured as the PIM Sparse Bootstrap Router (BSR). **Note**: If the word “local” does not appear in the field, this routing switch is the BSR. If the word “local” does appear, this routing switch is not the BSR.
Uptime	The amount of time the BSR has been running. **Note**: This field appears only if this routing switch is the BSR.
BSR priority or local BSR priority	The priority assigned to the interface for use during the BSR election process. During BSR election, the priorities of the candidate BSRs are compared and the interface with the highest BSR priority becomes the BSR. **Note**: If the word “local” does not appear in the field, this routing switch is the BSR. If the word “local” does appear, this routing switch is not the BSR.
Hash mask length	The number of significant bits in the IP multicast group comparison mask. This mask determines the IP multicast group numbers for which the routing switch can be a BSR. The default is 32 bits, which allows the routing switch to be a BSR for any valid IP multicast group number. **Note**: This field appears only if this routing switch is the BSR.
Next bootstrap message in	Indicates how many seconds will pass before the BSR sends its next Bootstrap message. **Note**: This field appears only if this routing switch is the BSR.
Next Candidate-PR-advertisement message in	Indicates how many seconds will pass before the BSR sends its next candidate PR advertisement message. **Note**: This field appears only if this routing switch is the BSR.

This Field...	Displays...
RP	Indicates the IP address of the Rendezvous Point (RP). **Note**: This field appears only if this routing switch is the BSR.
group prefixes	Indicates the multicast groups for which the RP listed by the previous field is a candidate RP. **Note**: This field appears only if this routing switch is the BSR.
Candidate-RP-advertisement period	Indicates how frequently the BSR sends candidate RP advertisement messages. **Note**: This field appears only if this routing switch is the BSR.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying Candidate RP Information

To display candidate RP information, use the following CLI method.

USING THE CLI

To display candidate RP information, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim rp-candidate

Next Candidate-RP-advertisement in 00:00:10
  RP: 207.95.7.1
    group prefixes:
    224.0.0.0 / 4

  Candidate-RP-advertisement period: 60
```

This example show information displayed on a routing switch that is a candidate RP. The following example shows the message displayed on a routing switch that is not a candidate RP.

```
HP9300(config-pim-router)# show ip pim rp-candidate
```

This system is not a Candidate-RP.

Syntax: show ip pim rp-candidate

This display shows the following information.

This Field...	Displays...
Candidate-RP-advertisement in	Indicates how many seconds will pass before the BSR sends its next RP message. **Note**: This field appears only if this routing switch is a candidate RP.
RP	Indicates the IP address of the Rendezvous Point (RP). **Note**: This field appears only if this routing switch is a candidate RP.
group prefixes	Indicates the multicast groups for which the RP listed by the previous field is a candidate RP. **Note**: This field appears only if this routing switch is a candidate RP.

This Field...	Displays...
Candidate-RP-advertisement period	Indicates how frequently the BSR sends candidate RP advertisement messages. **Note**: This field appears only if this routing switch is a candidate RP.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying RP-to-Group Mappings

To display RP-to-group mappings, use the following CLI method.

USING THE CLI

To display RP-to-group-mappings, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim rp-map

Group address        RP address
-------------------------------
239.255.162.1        207.95.7.1
```

Syntax: show ip pim rp-map

This display shows the following information.

This Field...	Displays...
Group address	Indicates the PIM Sparse multicast group address using the listed RP.
RP address	Indicates the IP address of the Rendezvous Point (RP) for the listed PIM Sparse group.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying RP Information for a PIM Sparse Group

To display RP information for a specific PIM Sparse group, use the following CLI method.

USING THE CLI

To display RP information for a PIM Sparse group, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim rp-hash 239.255.162.1

  RP: 207.95.7.1, v2
    Info source: 207.95.7.1, via bootstrap
```

Syntax: show ip pim rp-hash <group-addr>

The <group-addr> parameter is the address of a PIM Sparse IP multicast group.

This display shows the following information.

This Field...	Displays...
RP	Indicates the IP address of the Rendezvous Point (RP) for the specified PIM Sparse group. Following the IP address is the port or virtual interface through which this routing switch learned the identity of the RP.
Info source	Indicates the IP address on which the RP information was received. Following the IP address is the method through which this routing switch learned the identity of the RP.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying the RP Set List

To display the RP set list, use the following CLI method.

USING THE CLI

To display the RP set list, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim rp-set

Number of group prefixes = 1

Group prefix = 224.0.0.0/4      # RPs expected/received: 1
            RP 1: 207.95.7.1    priority=0    age=0
```

Syntax: show ip pim rp-set

This display shows the following information.

This Field...	Displays...
Number of group prefixes	The number f PIM Sparse group prefixes for which the RP is responsible.
Group prefix	Indicates the multicast groups for which the RP listed by the previous field is a candidate RP.
RPs expected/received	Indicates how many RPs were expected and received in the latest Bootstrap message.
RP <num>	Indicates the RP number. If there are multiple RPs in the PIM Sparse domain, a line of information for each of them is listed, and they are numbered in ascending numerical order.
priority	The RP priority of the candidate RP. During the election process, the candidate RP with the highest priority is elected as the RP.
age	The age (in seconds) of this RP-set. **Note**: If this routing switch is not a BSR, this field contains zero. Only the BSR ages the RP-set.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying Multicast Neighbor Information

To display information about the routing switch's IP Multicast neighbors, use either of the following methods.

USING THE CLI

To display information about the routing switch's PIM neighbors, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim nbr

Port Neighbor         Holdtime Age   UpTime
                      sec      sec   sec
e3/8   207.95.8.10      180      60    900
Port Neighbor         Holdtime Age   UpTime
                      sec      sec   sec
v1     207.95.6.2       180      60    900
```

Syntax: show ip pim nbr

This display shows the following information.

This Field...	Displays...
Port	The interface through which the routing switch is connected to the neighbor.
Neighbor	The IP interface of the PIM neighbor interface.
Holdtime sec	Indicates how many seconds the neighbor wants this routing switch to hold the entry for this neighbor in memory. The neighbor sends the Hold Time in its Hello packets. • If the routing switch receives a new Hello packet before the Hold Time received in the previous packet expires, the routing switch updates its table entry for the neighbor. • If the routing switch does not receive a new Hello packet from the neighbor before the Hold time expires, the routing switch assumes the neighbor is no longer available and removes the entry for the neighbor.
Age sec	The number of seconds since the routing switch received the last hello message from the neighbor.
UpTime sec	The number of seconds the PIM neighbor has been up. This timer starts when the routing switch receives the first Hello messages from the neighbor.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view.
3. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
4. Click on the Neighbor link to display the IP interface table.

Displaying the PIM Flow Cache

To display the PIM flow cache, use the following CLI method.

USING THE CLI

To display the PIM flow cache, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim flowcache

     Source          Group           Parent CamFlags CamIndex  Fid      Flags
1    209.157.24.162  239.255.162.1   v2     00000700 2023      00004411 F
2    209.157.24.162  239.255.162.1   v2     00000700 201b      00004411 F
3    209.157.24.162  239.255.162.1   v2     00000700 201d      00004411 F
4    209.157.24.162  239.255.162.1   v2     00000700 201e      00004411 F
```

Syntax: show ip pim flowcache

This display shows the following information.

This Field...	Displays...
Source	Indicates the source of the PIM Sparse group.
Group	Indicates the PIM Sparse group.
Parent	Indicates the port or virtual interface from which the routing switch receives packets from the group's source.
CamFlags	This field is used by HP technical support for troubleshooting.
CamIndex	This field is used by HP technical support for troubleshooting.
Fid	This field is used by HP technical support for troubleshooting.
Flags	This field is used by HP technical support for troubleshooting.

USING THE WEB MANAGEMENT INTERFACE

You cannot display the PIM flow cache using the Web management interface.

Displaying the PIM Multicast Cache

To display the PIM multicast cache, use the following CLI method.

USING THE CLI

To display the PIM multicast cache, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim mcache

1    (*,239.255.162.1) RP207.95.7.1 forward port v1, Count 2
     member ports ethe 3/3
     virtual ports v2
     prune ports
     virtual prune ports

2    (209.157.24.162,239.255.162.4) forward port v2, flags 00004900 Count 130
     member ports
     virtual ports
     prune ports
     virtual prune ports

3    (209.157.24.162,239.255.162.1) forward port v2, flags 00005a01 Count 12
     member ports ethe 3/8
     virtual ports
     prune ports
     virtual prune ports
```

Syntax: show ip pim mcache

This display shows the following information.

This Field...	Displays...
(*<source>*, *<group>*)	The comma-separated values in parentheses is a source-group pair. The *<source>* is the PIM source for the multicast *<group>*. For example, the following entry means source 209.157.24.162 for group 239.255.162.1: (209.157.24.162,239.255.162.1) If the *<source>* value is * (asterisk), this cache entry uses the RP path. The * value means "all sources". If the *<source>* is a specific source address, this cache entry uses the SPT path.
RP<ip-addr>	Indicates the RP for the group for this cache entry. **Note**: The RP address appears only if the RPT flag is set to 1 and the SPT flag is set to 0 (see below).
forward port	The port through which the routing switch reaches the source.
Count	The number of packets forwarded using this cache entry.
Sparse Mode	Indicates whether the cache entry is for regular PIM (dense mode) or PIM Sparse. This flag can have one of the following values: • 0 – The entry is not for PIM Sparse (and is therefore for the dense mode of PIM). • 1– The entry is for PIM Sparse.
RPT	Indicates whether the cache entry uses the RP path or the SPT path. The RPT flag can have one of the following values: • 0 – The SPT path is used instead of the RP path. • 1– The RP path is used instead of the SPT path. **Note**: The values of the RP and SPT flags are always opposite (one is set to 0 and the other is set to 1).
SPT	Indicates whether the cache entry uses the RP path or the SPT path. The SP flag can have one of the following values: • 0 – The RP path is used instead of the SPT path. • 1– The SPT path is used instead of the RP path. **Note**: The values of the RP and SPT flags are always opposite (one is set to 0 and the other is set to 1).
Register Suppress	Indicates whether the Register Suppress timer is running. This field can have one of the following values: • 0 – The timer is not running. • 1 – The timer is running.
member ports	Indicates the routing switch physical ports to which the receivers for the source and group are attached. The receivers can be directly attached or indirectly attached through other PIM Sparse routers.
virtual ports	Indicates the virtual interfaces to which the receivers for the source and group are attached. The receivers can be directly attached or indirectly attached through other PIM Sparse routers.

This Field...	Displays...
prune ports	Indicates the physical ports on which the routing switch has received a prune notification (in a Join/Prune message) to remove the receiver from the list of recipients for the group.
virtual prune ports	Indicates the virtual interfaces ports on which the routing switch has received a prune notification (in a Join/Prune message) to remove the receiver from the list of recipients for the group.

USING THE WEB MANAGEMENT INTERFACE

You cannot display the PIM multicast cache using the Web management interface.

Displaying PIM Traffic Statistics

To display PIM traffic statistics, use the following CLI method.

USING THE CLI

To display PIM traffic statistics, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim traffic

Port    Hello           J/P          Register       RegStop          Assert
     [Rx      Tx]     [Rx      Tx]     [Rx      Tx]     [Rx      Tx]     [Rx      Tx]
e3/8   19      19      32      0       0       0       37      0        0       0

Port    Hello           J/P          Register       RegStop          Assert
     [Rx      Tx]     [Rx      Tx]     [Rx      Tx]     [Rx      Tx]     [Rx      Tx]
v1     18      19      0       20      0       0       0       0        0       0

Port    Hello           J/P          Register       RegStop          Assert
     [Rx      Tx]     [Rx      Tx]     [Rx      Tx]     [Rx      Tx]     [Rx      Tx]
v2     0       19      0       0       0       16      0       0        0       0

Total 37      57      32      0       0       0       0       0        0       0
IGMP Statistics:
  Total Recv/Xmit 85/110
  Total Discard/chksum  0/0
```

Syntax: show ip pim traffic

NOTE: If you have configured interfaces for standard PIM (dense mode) on the routing switch, statistics for these interfaces are listed first by the display.

This display shows the following information.

This Field...	Displays...
Port	The port or virtual interface on which the PIM interface is configured.
Hello	The number of PIM Hello messages sent or received on the interface.
J/P	The number of Join/Prune messages sent or received on the interface. **Note**: Unlike PIM dense, PIM Sparse uses the same messages for Joins and Prunes.
Register	The number of Register messages sent or received on the interface.

This Field...	Displays...
RegStop	The number of Register Stop messages sent or received on the interface.
Assert	The number of Assert messages sent or received on the interface.
Total Recv/Xmit	The total number of IGMP messages sent and received by the routing switch.
Total Discard/chksum	The total number of IGMP messages discarded, including a separate counter for those that failed the checksum comparison.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM statistics using the Web management interface.

Configuring Multicast Source Discovery Protocol (MSDP)

The Multicast Source Discovery Protocol (MSDP) is used by Protocol Independent Multicast (PIM) Sparse routers to exchange routing information for PIM Sparse multicast groups across PIM Sparse domains. Routers running MSDP can discover PIM Sparse sources that are in other PIM Sparse domains.

PIM Sparse routers use MSDP to register PIM Sparse multicast sources in a domain with the Rendezvous Point (RP) for that domain.

Figure 9.4 shows an example of some PIM Sparse domains. For simplicity, this example show only one Designated Router (DR), one group source, and one receiver for the group. Only one PIM Sparse router within each domain needs to run MSDP.

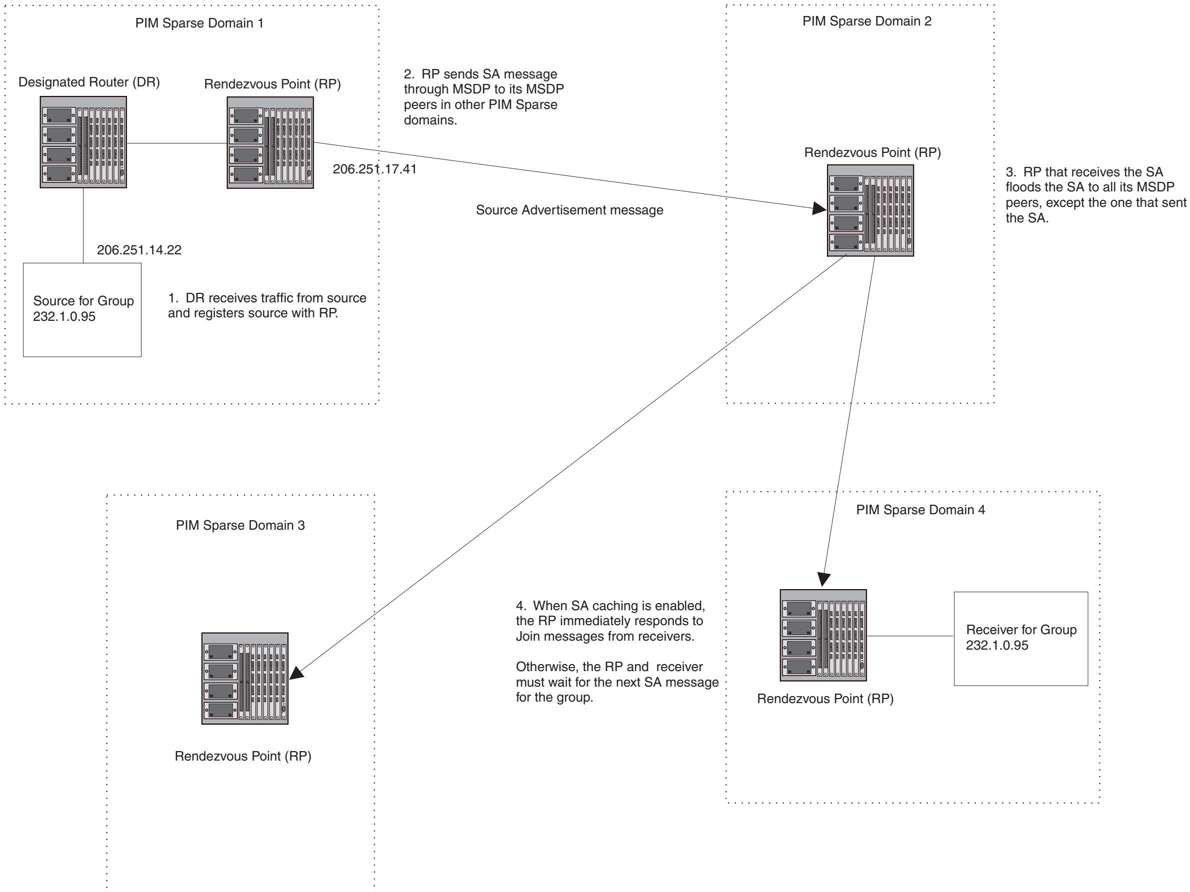


Figure 9.4 PIM Sparse domains joined by MSDP routers

In this example, the source for PIM Sparse multicast group 232.0.1.95 is in PIM Sparse domain 1. The source sends a packet for the group to its directly attached DR. The DR sends a Group Advertisement message for the group to the domain's RP. The RP is configured for MSDP, which enables the RP to exchange source information with other PIM Sparse domains by communicating with RPs in other domains that are running MSDP.

The RP sends the source information to each of its peers by sending a Source Active message. The message contains the IP address of the source, the group address to which the source is sending, and the IP address of the RP interface with its peer. In this example, the Source Active message contains the following information:

- Source address: 206.251.14.22
- Group address: 232.1.0.95
- RP address: 206.251.17.41

Figure 9.4 shows only one peer for the MSDP router (which is also the RP here) in domain 1, so the Source Active message goes to only that peer. When an MSDP router has multiple peers, it sends a Source Active message to each of those peers. Each peer sends the Source Advertisement to its other MSDP peers. The RP that receives the Source Active message also sends a Join message for the group if the RP that received the message has receivers for the group.

Peer Reverse Path Forwarding (RPF) Flooding

When the MSDP router (also the RP) in domain 2 receives the Source Active message from its peer in domain 1, the MSDP router in domain 2 forwards the message to all its other peers. The propagation process is sometimes called "peer Reverse Path Forwarding (RPF) flooding". This term refers to the fact that the MSDP router uses its

PIM Sparse RPF tree to send the message to its peers within the tree. In Figure 9.4, the MSDP router floods the Source Active message it receives from its peer in domain 1 to its other peers, in domains 3 and 4.

Note that the MSDP router in domain 2 does not forward the Source Active back to its peer in domain 1, because that is the peer from which the router received the message. An MSDP router never sends a Source Active message back to the peer that sent it. The peer that sent the message is sometimes called the “RPF peer”. The MSDP router uses the unicast routing table for its Exterior Gateway Protocol (EGP) to identify the RPF peer by looking for the route entry that is the next hop toward the source. Often, the EGP protocol is Border Gateway Protocol (BGP) version 4.

NOTE: MSDP depends on BGP and MBGP for interdomain operations.

The MSDP routers in domains 3 and 4 also forward the Source Active message to all their peers except the ones that sent them the message. Figure 9.4 does not show additional peers.

Source Active Caching

When an MSDP router that is also an RP receives a Source Active message, the RP checks its PIM Sparse multicast group table for receivers for the group. If the DR has a receiver for the group being advertised in the Source Active message, the DR sends a Join message for that receiver back to the DR in the domain from which the Source Active message came. Usually, the DR is also the MSDP router that sent the Source Active message.

In Figure 9.4, if the MSDP router and RP in domain 4 has a table entry for the receiver, the RP sends a Join message on behalf of the receiver back through the RPF tree to the RP for the source, in this case the RP in domain 1.

Some MSDP routers that are also RPs can cache Source Active messages. If the RP is not caching Source Active messages, the RP does not send a Join message unless it already has a receiver that wants to join the group. Otherwise, the RP does not send a Join message and does not remember the information in the Source Active message after forwarding it. If the RP receives a request from a receiver for the group, the RP and receiver must wait for the next Source Active message for that group before the RP can send a Join message for the receiver.

However, if Source Active caching is enabled on the MSDP and RP router, the RP caches the Source Active messages it receives. In this case, even if the RP does not have a receiver for a group when the RP receives the Source Active message for the group, the RP can immediately send a Join for a new receiver that wants to join the group, without waiting for the next Source Active message from the RP in the source’s domain.

Configuring MSDP

To configure MSDP on a routing switch, perform the following tasks:

- Enable MSDP.
- Configure the MSDP peers.

NOTE: The PIM Sparse Rendezvous Point (RP) is also an MSDP peer.

Enabling MSDP

Use the following CLI method to enable MSDP.

USING THE CLI

To enable MSDP, enter the following command at the global CONFIG level of the CLI. This command also places you at the MSDP configuration level of the CLI.

```
HP9300(config)# router msdp
HP9300(config-msdp-router)#
```

Syntax: [no] router msdp

USING THE WEB MANAGEMENT INTERFACE

You cannot configure MSDP using the Web management interface.

Configuring MSDP Peers

Use the following CLI method to configure an MSDP peer.

USING THE CLI

To configure an MSDP peer, enter a command such as the following at the MSDP configuration level.

```
HP9300(config-msdp-router)# msdp-peer 205.216.162.1
```

Syntax: [no] msdp-peer <ip-addr>

USING THE WEB MANAGEMENT INTERFACE

You cannot configure MSDP using the Web management interface.

Displaying MSDP Information

You can display the following MSDP information:

- Summary information – the IP addresses of the peers, the state of the routing switch's MSDP session with each peer, and statistics for Keepalive, Source Active, and Notification messages sent to and received from each of the peers
- Peer information – the IP address of the peer, along with detailed MSDP and TCP statistics
- Source Active cache entries – the Source Active messages cached by the routing switch

Displaying Summary Information

To display summary MSDP information, use the following CLI method.

USING THE CLI

To display summary MSDP information, enter the following command at any level of the CLI:

```
HP9300(config-msdp-router)# show ip msdp summary

MSDP Peer Status Summary
 KA: Keepalive SA:Source-Active NOT: Notification
 Peer Address     State          KA          SA          NOT
                             In     Out    In    Out    In   Out
 206.251.17.30    ESTABLISH   3      3      0     640    0     0
 206.251.17.41    ESTABLISH   0      3      651   0      0     0
```

Syntax: show ip msdp summary

This display shows the following information.

MSDP Summary Information

This Field...	Displays...
Peer Address	The IP address of the peer's interface with the routing switch
State	The state of the MSDP router's connection with the peer. The state can be one of the following: • CONNECTING – The session is in the active open state. • ESTABLISHED – The MSDP session is fully up. • INACTIVE – The session is idle. • LISTENING – The session is in the passive open state.

MSDP Summary Information (Continued)

This Field...	Displays...
KA In	The number of MSDP Keepalive messages the MSDP router has received from the peer
KA Out	The number of MSDP Keepalive messages the MSDP router has sent to the peer
SA In	The number of Source Active messages the MSDP router has received from the peer
SA Out	The number of Source Active messages the MSDP router has sent to the peer
NOT In	The number of Notification messages the MSDP router has received from the peer
NOT Out	The number of Notification messages the MSDP router has sent to the peer

USING THE WEB MANAGEMENT INTERFACE

You cannot display MSDP information using the Web management interface.

Displaying Peer Information

To display summary MSDP peer information, use the following CLI method.

USING THE CLI

To display MSDP peer information, use the following CLI method.

```
HP9300(config-msdp-router)# show ip msdp peer

        Total number of MSDP Peers: 2

        IP Address          State
1       206.251.17.30       ESTABLISHED
        Keep Alive Time  Hold Time
        60               90

                            Message Sent         Message Received
        Keep Alive          2                    3
        Notifications       0                    0
        Source-Active       0                    640
        Last Connection Reset Reason:Reason Unknown
        Notification Message Error Code Received:Unspecified
        Notification Message Error SubCode Received:Not Applicable
        Notification Message Error Code Transmitted:Unspecified
        Notification Message Error SubCode Transmitted:Not Applicable
        TCP Connection state: ESTABLISHED
          Local host:  206.251.17.29, Local  Port: 8270
          Remote host: 206.251.17.30, Remote Port: 639
          ISentSeq:      16927  SendNext:     685654  TotUnAck:          0
          SendWnd:       16384  TotSent:      668727  ReTrans:           1
          IRcvSeq:    45252428  RcvNext:    45252438  RcvWnd:        16384
          TotalRcv:         10  RcvQue:            0  SendQue:           0
```

Syntax: show ip msdp peer

This display shows the following information.

MSDP Peer Information

This Field...	Displays...
Total number of MSDP peers	The number of MSDP peers configured on the routing switch
IP Address	The IP address of the peer's interface with the routing switch
State	The state of the MSDP router's connection with the peer. The state can be one of the following: • CONNECTING – The session is in the active open state. • ESTABLISHED – The MSDP session is fully up. • INACTIVE – The session is idle. • LISTENING – The session is in the passive open state.
Keep Alive Time	The keep alive time, which specifies how often this MSDP router sends keep alive messages to the neighbor. The keep alive time is 60 seconds and is not configurable.
Hold Time	The hold time, which specifies how many seconds the MSDP router will wait for a KEEPALIVE or UPDATE message from an MSDP neighbor before deciding that the neighbor is dead. The hold time is 90 seconds and is not configurable.
Keep Alive Message Sent	The number of Keep Alive messages the MSDP router has sent to the peer.
Keep Alive Message Received	The number of Keep Alive messages the MSDP router has received from the peer.
Notifications Sent	The number of Notification messages the MSDP router has sent to the peer.
Notifications Received	The number of Notification messages the MSDP router has received from the peer.
Source-Active Sent	The number of Source Active messages the MSDP router has sent to the peer.
Source-Active Received	The number of Source Active messages the MSDP router has received from the peer.
Last Connection Reset Reason	The reason the previous session with this neighbor ended.

MSDP Peer Information (Continued)

This Field...	Displays...
Notification Message Error Code Received	If the MSDP router receives a NOTIFICATION messages from the neighbor, the message contains an error code corresponding to one of the following errors. Some errors have subcodes that clarify the reason for the error. Where applicable, the subcode messages are listed underneath the error code messages. • 1 – Message Header Error • 2 – SA-Request Error • 3 – SA-Message/SA-Response Error • 4 – Hold Timer Expired • 5 – Finite State Machine Error • 6 – Notification • 7 – Cease For information about these error codes, see section 17 in the Internet draft describing MSDP, “draft-ietf-msdp-spec”.
Notification Message Error SubCode Received	See above.
Notification Message Error Code Transmitted	The error message corresponding to the error code in the NOTIFICATION message this MSDP router sent to the neighbor. See the description for the Notification Message Error Code Received field for a list of possible codes.
Notification Message Error SubCode Transmitted	See above.

MSDP Peer Information (Continued)

This Field...	Displays...
TCP Statistics	
TCP connection state	The state of the connection with the neighbor. The connection can have one of the following states: • LISTEN – Waiting for a connection request. • SYN-SENT – Waiting for a matching connection request after having sent a connection request. • SYN-RECEIVED – Waiting for a confirming connection request acknowledgment after having both received and sent a connection request. • ESTABLISHED – Data can be sent and received over the connection. This is the normal operational state of the connection. • FIN-WAIT-1 – Waiting for a connection termination request from the remote TCP, or an acknowledgment of the connection termination request previously sent. • FIN-WAIT-2 – Waiting for a connection termination request from the remote TCP. • CLOSE-WAIT – Waiting for a connection termination request from the local user. • CLOSING – Waiting for a connection termination request acknowledgment from the remote TCP. • LAST-ACK – Waiting for an acknowledgment of the connection termination request previously sent to the remote TCP (which includes an acknowledgment of its connection termination request). • TIME-WAIT – Waiting for enough time to pass to be sure the remote TCP received the acknowledgment of its connection termination request. • CLOSED – There is no connection state.
Local host	The IP address of the MSDP router's interface with the peer.
Local port	The TCP port the MSDP router is using for the BGP4 TCP session with the neighbor.
Remote host	The IP address of the neighbor.
Remote port	The TCP port number of the peer end of the connection.
ISentSeq	The initial send sequence number for the session.
SendNext	The next sequence number to be sent.
TotUnAck	The number of sequence numbers sent by the MSDP router that have not been acknowledged by the neighbor.
SendWnd	The size of the send window.
TotSent	The number of sequence numbers sent to the neighbor.

MSDP Peer Information (Continued)

This Field...	Displays...
ReTrans	The number of sequence numbers that the MSDP router retransmitted because they were not acknowledged.
IRcvSeq	The initial receive sequence number for the session.
RcvNext	The next sequence number expected from the neighbor.
RcvWnd	The size of the receive window.
TotalRcv	The number of sequence numbers received from the neighbor.
RcvQue	The number of sequence numbers in the receive queue.
SendQue	The number of sequence numbers in the send queue.

USING THE WEB MANAGEMENT INTERFACE

You cannot display MSDP information using the Web management interface.

Displaying Source Active Cache Information

To display the Source Actives in the MSDP cache, use the following CLI method.

```
HP9300(config-msdp-router)# show ip msdp sa-cache

Total Entry 4096, Used 1800 Free 2296
Index  SourceAddr   GroupAddr           Age
1     (100.100.1.254,  232.1.0.95), RP:206.251.17.41, Age:0
2     (100.100.1.254,  237.1.0.98), RP:206.251.17.41, Age:30
3     (100.100.1.254,  234.1.0.48), RP:206.251.17.41, Age:30
4     (100.100.1.254,  239.1.0.51), RP:206.251.17.41, Age:30
5     (100.100.1.254,  234.1.0.154), RP:206.251.17.41, Age:30
6     (100.100.1.254,  236.1.0.1), RP:206.251.17.41, Age:30
7     (100.100.1.254,  231.1.0.104), RP:206.251.17.41, Age:90
8     (100.100.1.254,  239.1.0.157), RP:206.251.17.41, Age:30
9     (100.100.1.254,  236.1.0.107), RP:206.251.17.41, Age:30
10    (100.100.1.254,  233.1.0.57), RP:206.251.17.41, Age:90
```

Syntax: show ip msdp sa-cache

This display shows the following information.

MSDP Source Active Cache

This Field...	Displays...
Total Entry	The total number of entries the cache can hold.
Used	The number of entries the cache currently contains.
Free	The number of additional entries for which the cache has room.
Index	The cache entry number.
SourceAddr	The IP address of the multicast source.
GroupAddr	The IP multicast group to which the source is sending information.

MSDP Source Active Cache (Continued)

This Field...	Displays...
RP	The RP through which receivers can access the group traffic from the source
Age	The number of seconds the entry has been in the cache

USING THE WEB MANAGEMENT INTERFACE

You cannot display MSDP information using the Web management interface.

Clearing MSDP Information

You can clear the following MSDP information:

- Peer information
- Source Active cache
- MSDP statistics

Clearing Peer Information

To clear MSDP peer information, enter the following command at the Privileged EXEC level of the CLI:

```
HP9300# clear ip msdp peer 205.216.162.1
Remote connection closed
```

Syntax: clear ip msdp peer <ip-addr>

The command in this example clears the MSDP peer connection with MSDP router 205.216.162.1. The CLI displays a message to indicate when the connection has been successfully closed.

Clearing the Source Active Cache

To clear the entries from the Source Active cache, enter the following command at the Privileged EXEC level of the CLI:

```
HP9300# clear ip msdp sa-cache
```

Syntax: clear ip msdp sa-cache [<source-addr> | <group-addr>]

The command in this example clears all the cache entries. Use the <source-addr> parameter to clear only the entries for a specified course. Use the <group-addr> parameter to clear only the entries for a specific group.

Clearing MSDP Statistics

To clear MSDP statistics, enter the following command at the Privileged EXEC level of the CLI:

```
HP9300# clear ip msdp statistics
```

Syntax: clear ip msdp statistics [<ip-addr>]

The command in this example clears statistics for all the peers. To clear statistics for only a specific peer, enter the peer's IP address.

DVMRP Overview

HP routing switches provide multicast routing with the ***Distance Vector Multicast Routing Protocol (DVMRP)*** routing protocol. DVMRP uses ***Internet Group Membership Protocol (IGMP)*** to manage the IP multicast groups.

DVMRP is a broadcast and pruning multicast protocol that delivers IP multicast datagrams to its intended receivers. The receiver registers the interested groups using IGMP. DVMRP builds a multicast delivery tree with the sender forming the root. Initially, multicast datagrams are delivered to all nodes on the tree. Those leaves that do not have any group members send ***prune messages*** to the upstream router, noting the absence of a group. The upstream router maintains a prune state for this group for the given sender. A prune state is aged out after a given configurable interval, allowing multicasts to resume.

DVMRP employs ***reverse path forwarding*** and ***pruning*** to keep source specific multicast delivery trees with the minimum number of branches required to reach all group members. DVMRP builds a multicast tree for each source and destination host group.

Initiating DVMRP Multicasts on a Network

Once DVMRP is enabled on each router, a network user can begin a video conference multicast from the server on R1. ***Multicast Delivery Trees*** are initially formed by source-originated multicast packets that are propagated to downstream interfaces as seen in Figure 9.5. When a multicast packet is received on a DVMRP-capable router interface, the interface checks its DVMRP routing table to determine whether the interface that received the message provides the shortest path back to the source. If the interface does provide the shortest path, the interface forwards the multicast packet to adjacent peer DVMRP routers, except for the router interface that originated the packet. Otherwise, the interface discards the multicast packet and sends a prune message back upstream. This process is known as ***reverse path forwarding***.

In Figure 9.5, the root node (R1) is forwarding multicast packets for group 229.225.0.2 that it receives from the server to its downstream nodes, R2, R3, and R4. Router R4 is an intermediate router with R5 and R6 as its downstream routers. Because R5 and R6 have no downstream interfaces, they are leaf nodes.

The receivers in this example are those workstations that are resident on routers R2, R3, and R6.

Pruning a Multicast Tree

After the multicast tree is constructed, ***pruning*** of the tree will occur after IP multicast packets begin to traverse the tree.

As multicast packets reach leaf networks (sub-nets with no downstream interfaces), the local IGMP database checks for the recently arrived IP multicast packet address. If the local database does not contain the address (the address has not been learned), the router prunes (removes) the address from the multicast tree and no longer receives multicasts until the prune age expires.

In Figure 9.6, Router 5 is a leaf node with no group members in its local database. Consequently, Router 5 sends a prune message to its upstream router. This router will not receive any further multicast traffic until the prune age interval expires.

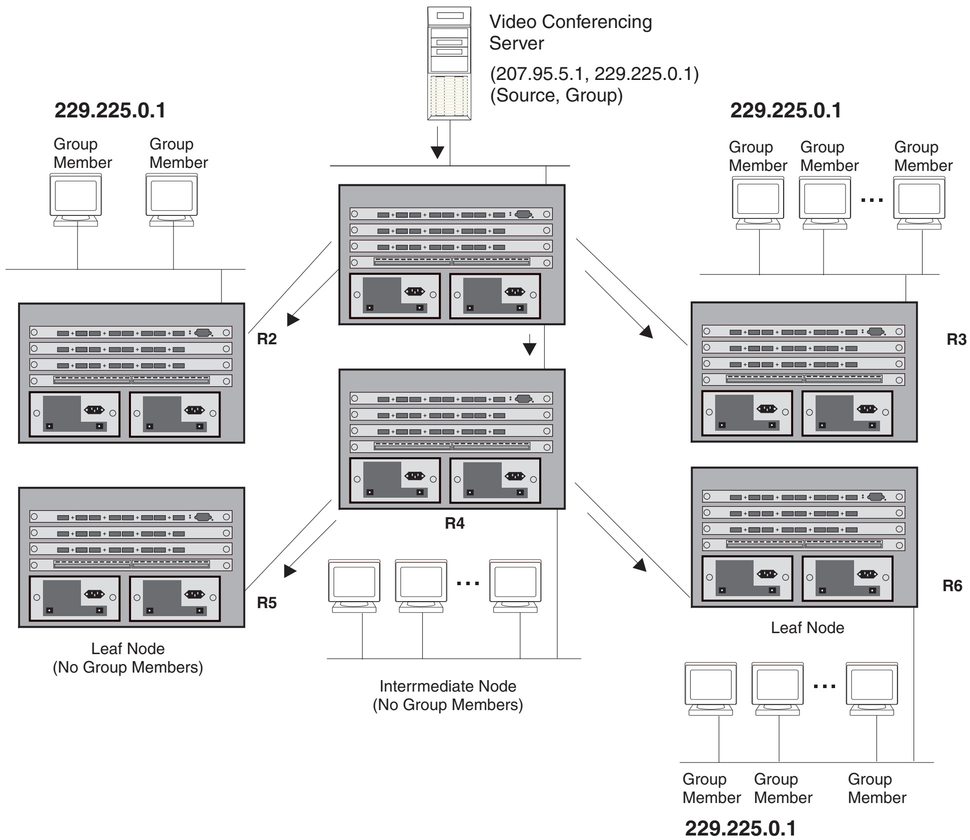


Figure 9.5 Downstream broadcast of IP multicast packets from source host

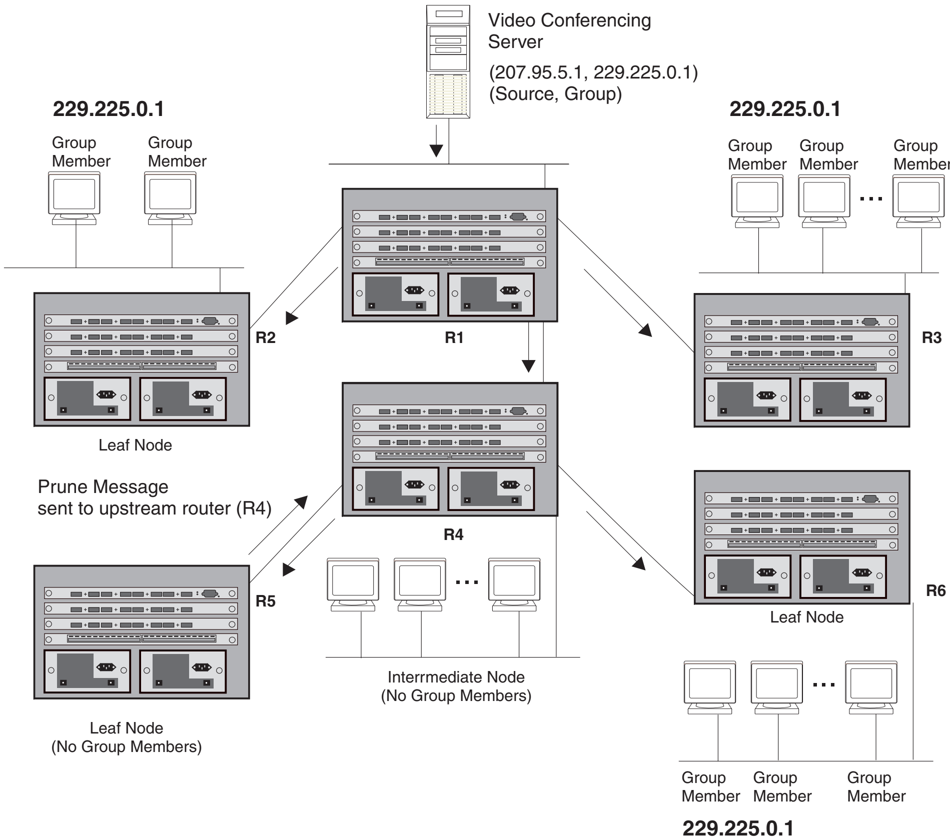


Figure 9.6 Pruning leaf nodes from a multicast tree

Grafts to a Multicast Tree

A DVMRP router restores pruned branches to a multicast tree by sending graft messages towards the upstream router. Graft messages start at the leaf node and travel up the tree, first sending the message to its neighbor upstream router.

In the example above, if a new 229.255.0.1 group member joins on router R6, which had been pruned previously, a graft will be sent upstream to R4. Since the forwarding state for this entry is in a prune state, R4 sends a graft to R1. Once R4 has joined the tree, it along with R6 will once again receive multicast packets.

You do not need to perform any configuration to maintain the multicast delivery tree. The prune and graft messages automatically maintain the tree.

Configuring DVMRP

Enabling DVMRP on the Routing Switch and Interface

Suppose you want to initiate the use of desktop video for fellow users on a sprawling campus network. All destination workstations have the appropriate hardware and software but the routing switches that connect the various buildings need to be configured to support DVMRP multicasts from the designated video conference server as seen in Figure 9.5.

DVMRP is enabled on each of the HP routing switches shown in Figure 9.5, on which multicasts are expected. You can enable DVMRP on each routing switch independently or remotely from one HP 9308M by a Telnet connection. Follow the same steps for each routing switch. A reset of the routing switch is required when DVMRP is first enabled. Thereafter, all changes are dynamic.

NOTE: By default, the DVMRP feature is disabled. To enable DVMRP on router1, enable DVMRP at the global level and then on each interface that will support the protocol.

USING THE CLI

To enable DVMRP on Router 1 and interface 3, enter the following:

```
Router1(config)# router dvmrp
Router1(config-dvmrp-router)# int e 3
Router1(config-if-3)# ip dvmrp
```

USING THE WEB MANAGEMENT INTERFACE

To enable DVMRP on Router 1 and interface 3, enter the following:

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled DVMRP, enable it by clicking on the Enable radio button next to DVMRP on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
5. Click on the Virtual Interface link to display the DVMRP Interface configuration panel.

NOTE: If the device already has DVMRP interfaces, a table listing the interfaces is displayed. Click the Modify button to the right of the row describing an interface to change its configuration, or click the Add Virtual Interface link to display the DVMRP Interface configuration panel.

---

6. Select the interface type. You can select Subnet or Tunnel.
7. Select the IP address of the interface being configured from the Local Address pulldown menu.
8. If you are configuring an IP Tunnel, enter the IP address of the destination interface, the end point of the IP Tunnel, in the Remote Address field. IP tunneling must also be enabled and defined on the destination router interface as well.

NOTE: The Remote Address field applies only to tunnel interfaces, not to sub-net interfaces.

---

9. Modify the time to live threshold (TTL) if necessary. The TTL defines the minimum value required in a packet in order for the packet to be forwarded out the interface.

NOTE: For example, if the TTL for an interface is set at 10, it means that only those packets with a TTL value of 10 or more will be forwarded. Likewise, if an interface is configured with a TTL Threshold value of 1, all packets received on that interface will be forwarded. Possible values are 1 – 64. The default value is 1.

---

10. Click Enable or Disable next to Advertise Local to enable or disable the feature.

11. Click Enable or Disable next to Encapsulation to enable or disable the feature.
12. Click the Add button to save the change to the device's running-config file.
13. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.
14. Click on the plus sign next to Command in the tree view to list the command options.
15. Select the Reload link and select Yes when prompted to reload the software. You must reload after enabling DVMRP to place the change into effect. If DVMRP was already enabled when you added the interface, you do not need to reload.

Modifying DVMRP Global Parameters

DVMRP global parameters come with preset values. The defaults work well in most networks, but you can modify the following global parameters if you need to:

- Neighbor timeout
- Route expire time
- Route discard time
- Prune age
- Graft retransmit time
- Probe interval
- Report interval
- Trigger interval
- Default route

Modifying Neighbor Timeout

The neighbor timeout specifies the period of time that a routing switch will wait before it defines an attached DVMRP neighbor router as down. Possible values are 40 – 8000 seconds. The default value is 180 seconds.

USING THE CLI

To modify the neighbor timeout value to 100, enter the following:

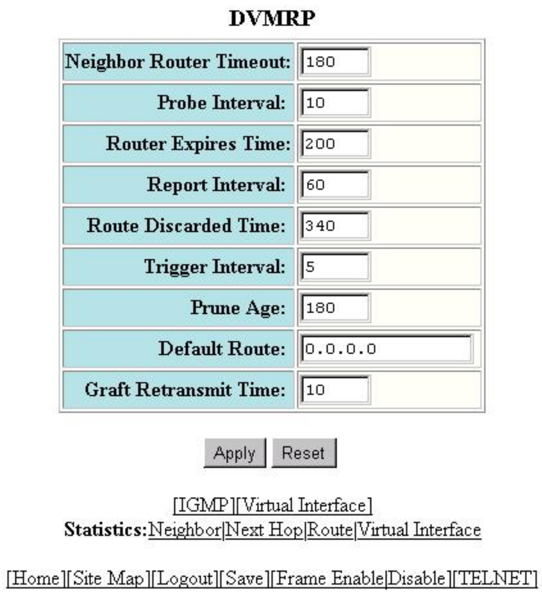
```
HP9300(config-dvmrp-router)# nbr 100
```

Syntax: nbr-timeout <40-8000>

The default is 180 seconds.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel, as shown in the following example.



5. Enter a value from 40 – 8000 into the Neighbor Router Timeout field.
6. Click the Apply button to save the change to the device’s running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Modifying Route Expires Time

The Route Expire Time defines how long a route is considered valid in the absence of the next route update. Possible values are from 20 – 4000 seconds. The default value is 200 seconds.

USING THE CLI

To modify the route expire setting to 50, enter the following:

```
HP9300(config-dvmrp-router)# route-expire-timeout 50
```

Syntax: route-expire-timeout <20-4000>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 20 – 4000 in the Route Expire Time field.
6. Click the Apply button to save the change to the device’s running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Modifying Route Discard Time

The Route Discard Time defines the period of time before a route is deleted. Possible values are from 40 – 8000 seconds. The default value is 340 seconds.

USING THE CLI

To modify the route discard setting to 150, enter the following:

```
HP9300(config-dvmrp-router)# route-discard-timeout 150
```

Syntax: route-discard-timeout <40-8000>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 40 – 8000 in the Route Discard Time field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Prune Age

The Prune Age defines how long a prune state will remain in effect for a source-routed multicast tree. After the prune age period expires, flooding will resume. Possible values are from 20 – 3600 seconds. The default value is 180 seconds.

USING THE CLI

To modify the prune age setting to 150, enter the following:

```
HP9300(config-dvmrp-router)# prune 25
```

Syntax: prune-age <20-3600>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 20 – 3600 in the Prune Age field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Graft Retransmit Time

The Graft Retransmit Time defines the initial period of time that a routing switch sending a graft message will wait for a graft acknowledgement from an upstream router before re-transmitting that message.

Subsequent retransmissions are sent at an interval twice that of the preceding interval. Possible values are from 5 – 3600 seconds. The default value is 10 seconds.

USING THE CLI

To modify the setting for graft retransmit time to 120, enter the following:

```
HP9300(config-dvmrp-router)# graft 120
```

Syntax: graft-retransmit-time <5-3600>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.

3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 5 – 3600 in the Graft Retransmit Time field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Probe Interval

The Probe Interval defines how often neighbor probe messages are sent to the ALL-DVMRP-ROUTERS IP multicast group address. A router's probe message lists those neighbor DVMRP routers from which it has received probes. Possible values are from 5 – 30 seconds. The default value is 10 seconds.

USING THE CLI

To modify the probe interval setting to 10, enter the following:

```
HP9300(config-dvmrp-router)# probe 10
```

Syntax: probe-interval <5-30>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 5 – 30 in the Probe Interval field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Report Interval

The Report Interval defines how often routing switches propagate their complete routing tables to other neighbor DVMRP routers. Possible values are from 10 – 2000 seconds. The default value is 60 seconds.

USING THE CLI

To support propagation of DVMRP routing information to the network every 90 seconds, enter the following:

```
HP9300(config-dvmrp-router)# report 90
```

Syntax: report-interval <10-2000>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 10 – 2000 in the Report Interval field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Trigger Interval

The Trigger Interval defines how often trigger updates, which reflect changes in the network topology, are sent. Example changes in a network topology include router up or down or changes in the metric. Possible values are from 5 – 30 seconds. The default value is 5 seconds.

USING THE CLI

To support the sending of trigger updates every 20 seconds, enter the following:

```
HP9300(config-dvmrp-router)# trigger-interval 20
```

Syntax: trigger-interval <5-30>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 5 – 30 in the Trigger Interval field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Default Route

This defines the default gateway for IP multicast routing.

USING THE CLI

To define the default gateway for DVMRP, enter the following:

```
HP9300(config-dvmrp-router)# default-gateway 192.35.4.1
```

Syntax: default-gateway <ip-addr>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter the IP address of the default gateway in the Default Route field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying DVMRP Interface Parameters

DVMRP global parameters come with preset values. The defaults work well in most networks, but you can modify the following interface parameters if you need to:

- TTL
- Metric
- Advertising
- Encapsulation

The following paragraphs provide an overview and configuration details for DVMRP global parameters.

Modifying the TTL

The TTL defines the minimum value required in a packet in order for the packet to be forwarded out the interface. For example, if the TTL for an interface is set at 10 it means that only those packets with a TTL value of 10 or more are forwarded. Likewise, if an interface is configured with a TTL Threshold value of 1, all packets received on that interface are forwarded. Possible values are from 1 – 64. The default value is 1.

USING THE CLI

To set a TTL of 64, enter the following:

```
HP9300(config)# int e 1/4
HP9300(config-if-1/4)# ip dvmrp ttl 60
```

Syntax: ttl-threshold <1-64>

USING THE WEB MANAGEMENT INTERFACE

To modify a DVMRP interface's TTL:

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Select the Virtual Interface link to display a table listing the configured DVMRP Interfaces.
5. Click on the Modify button next to the interface you want to modify. The DVMRP Interface configuration panel is displayed.
6. Enter a value from 1 – 64 in the Time To Live Threshold (TTL) field.
7. Click the Add button to save the changes to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying the Metric

The routing switch uses the metric when establishing reverse paths to some networks on directly attached interfaces. Possible values are from 1 – 31 hops. The default is 1.

NOTE: This command is not supported on HP switches.

USING THE CLI

To set a metric of 15 for a DVMRP interface, enter the following:

```
HP9300(config)# interface 3/5
HP9300(config-if-3/5)# ip dvmrp metric 15
```

Syntax: ip dvmrp metric <1-31>

USING THE WEB MANAGEMENT INTERFACE

To modify a DVMRP interface's metric:

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Select the Virtual Interface link to display a table listing the configured DVMRP Interfaces.
5. Click on the Modify button next to the interface you want to modify. The DVMRP Interface configuration panel is displayed.
6. Enter a value from 1 – 31 in the Metric field.
7. Click the Add button to save the changes to the device's running-config file.

8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

NOTE: You also can access the dialog for saving configuration changes by clicking on Command in the tree view, then clicking on Save to Flash.

Enabling Advertising

You can turn the advertisement of a local route on (enable) or off (disable) on the interface. By default, advertising is enabled.

USING THE CLI

To enable advertising on an interface, enter the following:

```
HP9300(config-if-1/4)# ip dvmrp advertise-local on
```

Syntax: advertise-local on | off

USING THE WEB MANAGEMENT INTERFACE

To enable local advertising on a DVMRP interface:

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Select the Virtual Interface link to display a table listing the configured DVMRP Interfaces.
5. Click on the Modify button next to the interface you want to modify. The DVMRP Interface configuration panel is displayed.
6. Select Enable next to Advertise Local.
7. Click the Add button to save the changes to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Enabling Encapsulation

Encapsulation varies based on the interface type. For type "IP tunnel", DVMRP control messages such as probe and route report are encapsulated within the IP packet. For type "sub-net", the IP data is encapsulated within an IP packet. Encapsulation is disabled by default.

USING THE CLI

To enable and define encapsulation type for DVMRP, enter the following:

```
HP9300(config)# int e 1/6
HP9300(config-if-1/6)# ip dvmrp encap ethernet-2
```

Syntax: ip dvmrp encapsulation ethernet-2 | snap

USING THE WEB MANAGEMENT INTERFACE

To enable encapsulation on a DVMRP interface:

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Select the Virtual Interface link to display a table listing the configured DVMRP Interfaces.
5. Click on the Modify button next to the interface you want to modify. The DVMRP Interface configuration panel is displayed.

6. Select Enable next to Encapsulation.
7. Click the Add button to save the changes to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring an IP Tunnel

IP tunnels are used to send traffic through routers that do not support PIM or DVMRP multicasting. IP multicast datagrams are encapsulated within an IP packet and then sent to the remote address. Routers that are not configured for PIM or DVMRP route that packet as a normal IP packet. When the DVMRP or PIM router at the remote end of the tunnel receives the packet, the router strips off the IP encapsulation and forwards the packet as an IP Multicast packet.

NOTE: An IP tunnel must have a remote IP interface at each end. Also, for IP tunneling to work, the remote routers must be reachable by an IP routing protocol.

NOTE: Multiple tunnels configured on a router cannot share the same remote address.

EXAMPLE:

To configure an IP tunnel as seen in Figure 9.7, enter the IP tunnel destination address on an interface of the routing switch.

USING THE CLI

To configure an IP address on Router A, enter the following:

```
HP9300(config)# int e1
HP9300(config-if-1)# ip tunnel 192.3.45.6
```

NOTE: The IP tunnel address represents the configured IP tunnel address of the destination router. In the case of Router A, its destination router is Router B. Router A is the destination router of Router B.

For Router B, enter the following:

```
HP9300(config-if-1)# ip tunnel 192.58.4.1
```

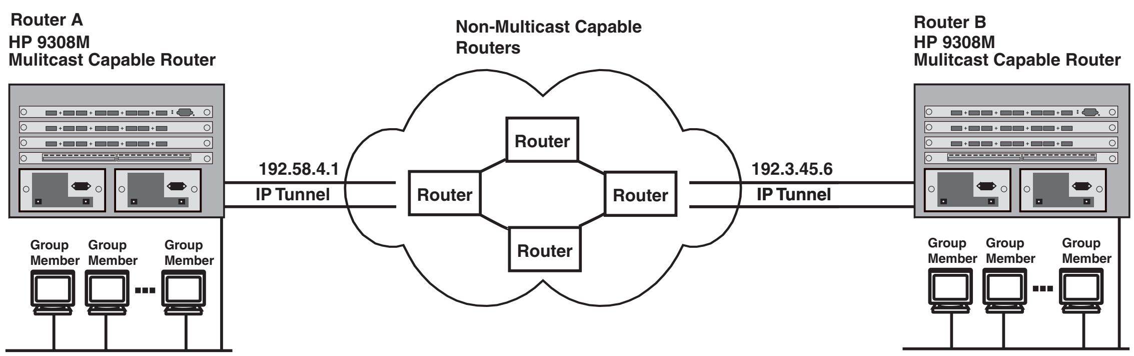


Figure 9.7 IP in IP tunneling on multicast packets in a unicast network

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.

4. Click on the Virtual Interface link to display the DVMRP Interface configuration panel.

NOTE: If the device already has DVMRP interfaces, a table listing the interfaces is displayed. Click the Modify button to the right of the row describing an interface to change its configuration, or click the Add Virtual Interface link to display the DVMRP Interface configuration panel.

---

5. Select the interface type. You can select Subnet or Tunnel. In this case, select Tunnel.
6. Select the IP address of the interface being configured from the Local Address pulldown menu.
7. Enter the IP address of the destination interface, the end point of the IP Tunnel, in the Remote Address field. IP tunneling must also be enabled and defined on the destination router interface as well.
8. Modify the time to live threshold (TTL) if necessary. The TTL defines the minimum value required in a packet in order for the packet to be forwarded out the interface.

NOTE: For example, if the TTL for an interface is set at 10, it means that only those packets with a TTL value of 10 or more will be forwarded. Likewise, if an interface is configured with a TTL Threshold value of 1, all packets received on that interface will be forwarded. Possible values are 1 – 64. The default value is 1.

---

9. Click Enable or Disable next to Advertise Local to enable or disable the feature.
10. Click Enable or Disable next to Encapsulation to enable or disable the feature.
11. Click the Add button to save the change to the device's running-config file.
12. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.
13. Repeat the steps above on the router that has the interface on the remote end of the IP tunnel.

Configuring a Static Multicast Route

Static multicast routes allow you to control the network path used by multicast traffic. Static multicast routes are especially useful when the unicast and multicast topologies of a network are different. You can avoid the need to make the topologies similar by instead configuring static multicast routes.

NOTE: This feature is not supported for DVMRP.

You can configure more than one static multicast route. The routing switch always uses the most specific route that matches a multicast source address. Thus, if you want to configure a multicast static route for a specific multicast source and also configure another multicast static route for all other sources, you can configure two static routes as shown in the examples below.

To add a static route for a multicast source network, use one of the following methods.

USING THE CLI

To add static routes to multicast router A (see Figure 9.8), enter commands such as the following:

```
HP9300(config)# ip mroute 1 207.95.10.0 255.255.255.0 interface ethernet 1/2
distance 1
HP9300(config)# ip mroute 2 0.0.0.0 0.0.0.0 interface ethernet 2/3 distance 1
HP9300(config)# write memory
```

Syntax: mroute <route-num> <ip-addr> interface ethernet <portnum> | ve <num> [distance <num>]

Or

Syntax: mroute <route-num> <ip-addr> rpf_address <rpf-num>

The <route-num> parameter specifies the route number.

The <ip-addr> command specifies the PIM source for the route.

NOTE: In IP multicasting, a route is handled in terms of its source, rather than its destination.

You can use the **ethernet** <portnum> parameter to specify a physical port or the **ve** <num> parameter to specify a virtual interface.

The **distance** <num> parameter sets the administrative distance for the route. When comparing multiple paths for a route, the routing switch prefers the path with the lower administrative distance.

NOTE: Regardless of the administrative distances, the routing switch always prefers directly connected routes over other routes.

The **rpf_address** <rpf-num> parameter specifies an RPF number.

The example above configures two static multicast routes. The first route is for a specific source network, 207.95.10.0/24. If the routing switch receives multicast traffic for network 207.95.10.0/24, the traffic must arrive on port 1/2. The second route is for all other multicast traffic. Traffic from multicast sources other than 207.95.10.0/24 must arrive on port 2/3.

Figure 9.8 shows an example of an IP Multicast network. The two static routes configured in the example above apply to this network. The commands in the example above configure PIM router A to accept PIM packets from 207.95.10.0/24 when they use the path that arrives at port 1/2, and accept all other PIM packets only when they use the path that arrives at port 2/3.

The distance parameter sets the administrative distance. This parameter is used by the software to determine the best path for the route. Thus, to ensure that the routing switch uses the default static route, assign a low administrative distance value. When comparing multiple paths for a route, the routing switch prefers the path with the lower administrative distance.

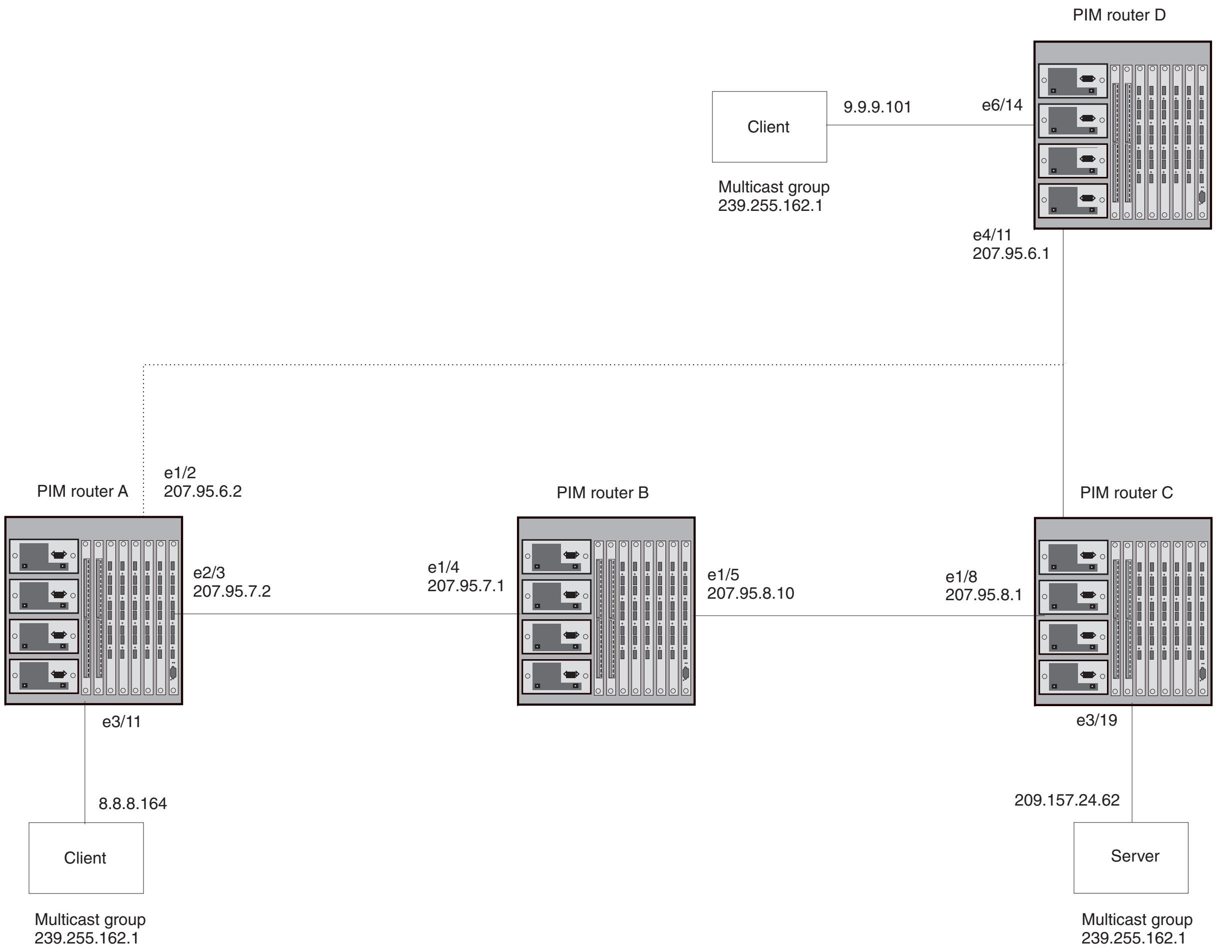


Figure 9.8 Example multicast static routes

To add a static route to a virtual interface, enter commands such as the following:

```
HP9300(config)# mroute 3 0.0.0.0 0.0.0.0 int ve 1 distance 1
HP9300(config)# write memory
```

USING THE WEB MANAGEMENT INTERFACE

You cannot configure a static multicast route using the Web management interface.

Tracing a Multicast Route

The HP implementation of Mtrace is based on “A ‘traceroute’ facility for IP Multicast”, an Internet draft by S. Casner and B. Fenner. To trace a PIM route, use the following CLI method.

NOTE: This feature is not supported for DVMRP.

USING THE CLI

To trace a PIM route to PIM source 209.157.24.62 in group 239.255.162.1, enter a command such as the following:

```
HP9300# mtrace source 209.157.24.62 group 239.255.162.1

Type Control-c to abort
```

```
Tracing the route for tree 209.157.23.188

 0   207.95.7.2
 0   207.95.7.2 Thresh 0
 1   207.95.7.1 Thresh 0
 2   207.95.8.1 Thresh 0
 3   207.157.24.62
```

Syntax: mtrace source <ip-addr> group <multicast-group>

The **source** <ip-addr> parameter specifies the address of the route's source.

NOTE: In IP multicasting, a route is handled in terms of its source, rather than its destination. When you trace an IP route, you specify its destination, but when you trace a PIM route, you specify its source.

The **group** <multicast-group> parameter specifies the PIM group the source IP address is in.

Figure 9.9 shows an example of an IP multicast group. The command example shown above is entered on PIM router A

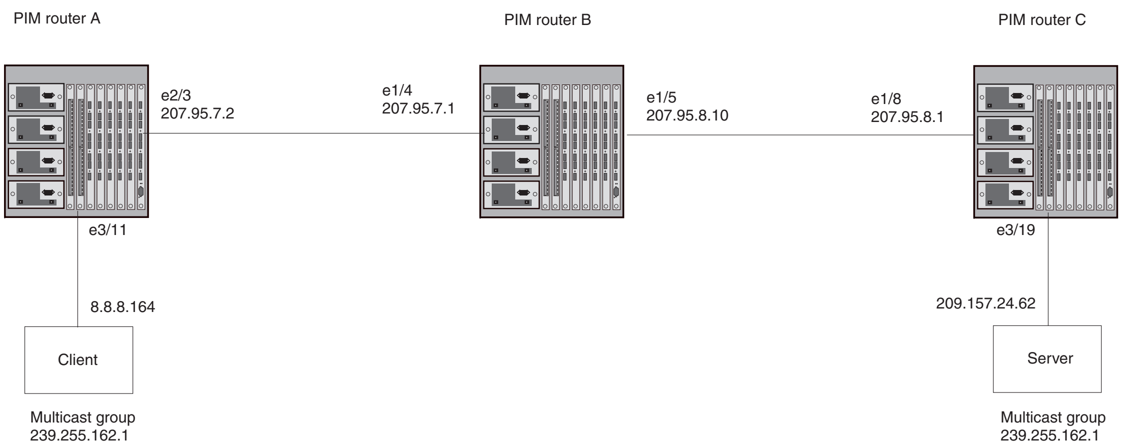


Figure 9.9 Example PIM Group

The command example above indicates that the source address 209.157.24.62 is three hops (three PIM routers) away from PIM router A. In PIM terms, each of the three routers has a forwarding state for the specified source address and multicast group. The value following "Thresh" in some of the lines indicates the TTL threshold. The threshold 0 means that all multicast packets are forwarded on the interface. If an administrator has set the TTL threshold to a higher value, only packets whose TTL is higher than the threshold are forwarded on the interface. The threshold is listed only for the PIM router hops between the source and destination.

USING THE WEB MANAGEMENT INTERFACE

You cannot trace a PIM route using the Web management interface.

Displaying Another Multicast Router's Multicast Configuration

The HP implementation of Mrinfo is based on the DVMRP Internet draft by T. Pusateri, but applies to PIM and not to DVMRP. To display the PIM configuration of another PIM router, use the following CLI method.

NOTE: This feature is not supported for DVMRP.

USING THE CLI

To display another PIM router's PIM configuration, enter a command such as the following:

```
HP9300# mrinfo 207.95.8.1
207.95.8.1 -> 207.95.8.10 [PIM/0 /1 ]
207.95.10.2 -> 0.0.0.0 [PIM/0 /1 /leaf]
209.157.25.1 -> 0.0.0.0 [PIM/0 /1 /leaf]
209.157.24.1 -> 0.0.0.0 [PIM/0 /1 /leaf]
207.95.6.1 -> 0.0.0.0 [PIM/0 /1 /leaf]
128.2.0.1 -> 0.0.0.0 [PIM/0 /1 /leaf]
```

Syntax: mrinfo <ip-addr>

The <ip-addr> parameter specifies the IP address of the PIM router.

The output in this example is based on the PIM group shown in Figure 9.9 on page 9-54. The output shows the PIM interfaces configured on PIM router C (207.95.8.1). In this example, the PIM router has six PIM interfaces. One of the interfaces goes to PIM router B. The other interfaces go to leaf nodes, which are multicast end nodes attached to the router's PIM interfaces. (For simplicity, the figure shows only one leaf node.)

When the arrow following an interface in the display points to a router address, this is the address of the next hop PIM router on that interface. In this example, PIM interface 207.95.8.1 on PIM router 207.95.8.1 is connected to PIM router 207.95.8.10. The connection can be a direct one or can take place through non-PIM routers. In this example, the PIM routers are directly connected.

When the arrow following an interface address points to zeros (0.0.0.0), the interface is not connected to a PIM router. The interface is instead connected to a leaf node.

NOTE: This display shows the PIM interface configuration information, but does not show the link states for the interfaces.

The information in brackets indicates the following:

- The multicast interface type (always PIM; this display is not supported for DVMRP)
- The Time-to-Live (TTL) for the interface.
- The metric for the interface
- Whether the interface is connected to a leaf node ("leaf" indicates a leaf node and blank indicates another PIM router)

For example, the information for the first interface listed in the display is "PIM/0 /1". This information indicates that the interface is a PIM interface, has a TTL of 0, and a metric of 1. The interface is not a leaf node interface and thus is an interface to another PIM router.

The information for the second interface in the display is "PIM/0 /1/leaf". This information indicates that the interface is a PIM interface, has a TTL of 0 and a metric of 1, and is connected to a leaf node.

USING THE WEB MANAGEMENT INTERFACE

You cannot display another router's PIM configuration using the Web management interface.

Chapter 10
Configuring BGP4

This chapter provides details on how to configure ***Border Gateway Protocol version 4 (BGP4)*** on HP products using the CLI and the Web management interface. BGP4 is supported on the following HP products:

- HP 9308M and HP 9304M routing switches
- HP 6308M-SX routing switch

NOTE: BGP4 is not supported on the HP 6208M-SX.

BGP4 is described in RFC 1771. The HP implementation fully complies with RFC 1771. The HP BGP4 implementation also supports the following RFCs:

- RFC 1745 (OSPF Interactions)
- RFC 1965 (BGP4 Confederations)
- RFC 1997 (BGP Communities Attributes)
- RFC 2385 (TCP MD5 Signature Option)
- RFC 2439 (Route Flap Dampening)
- RFC 2796 (Route Reflection)
- RFC 2842 (Capability Advertisement)

To display BGP4 configuration information and statistics, see “Displaying BGP4 Information” on page 10-84.

This chapter shows the commands you need in order to configure the HP routing switch for BGP4. For a detailed list of all CLI commands, including syntax and possible values, see the *Command Line Interface Reference*.

NOTE: Your routing switch’s management module must have 32MB or higher to run BGP4.

NOTE: The HP 6308M-SX and HP 9304M or HP 9308M routing switches using non-redundant management modules can contain 10,000 routes by default. If you need to increase the capacity of the IP route table for BGP4, see the “Displaying and Modifying System Parameter Default Settings“ section in the “Configuring Basic Features“ chapter of the *Installation and Getting Started Guide*.

Overview of BGP4

BGP4 is the standard Exterior Gateway Protocol (EGP) used on the Internet to route traffic between ***Autonomous Systems (AS)*** and to maintain loop-free routing. An autonomous system is a collection of

networks that share the same routing and administration characteristics. For example, a corporate intranet consisting of several networks under common administrative control might be considered an AS. The networks in an AS can but do not need to run the same routing protocol to be in the same AS, nor do they need to be geographically close.

Routers within an AS can use different Interior Gateway Protocols (IGPs) such as RIP and OSPF to communicate with one another. However, for routers in different ASs to communicate, they need to use an EGP. BGP4 is the standard EGP used by Internet routers and therefore is the EGP implemented on HP routing switches.

Figure 10.1 on page 10-2 shows a simple example of two BGP4 ASs. Each AS contains three BGP4 routers. All of the BGP4 routers within an AS communicate using IBGP. BGP4 routers communicate with other ASs using EBGP. Notice that each of the routers also is running an Interior Gateway Protocol (IGP). The routers in AS1 are running OSPF and the routers in AS2 are running RIP. HP routing switches can be configured to redistribute routes among BGP4, RIP, and OSPF. They also can redistribute static routes.

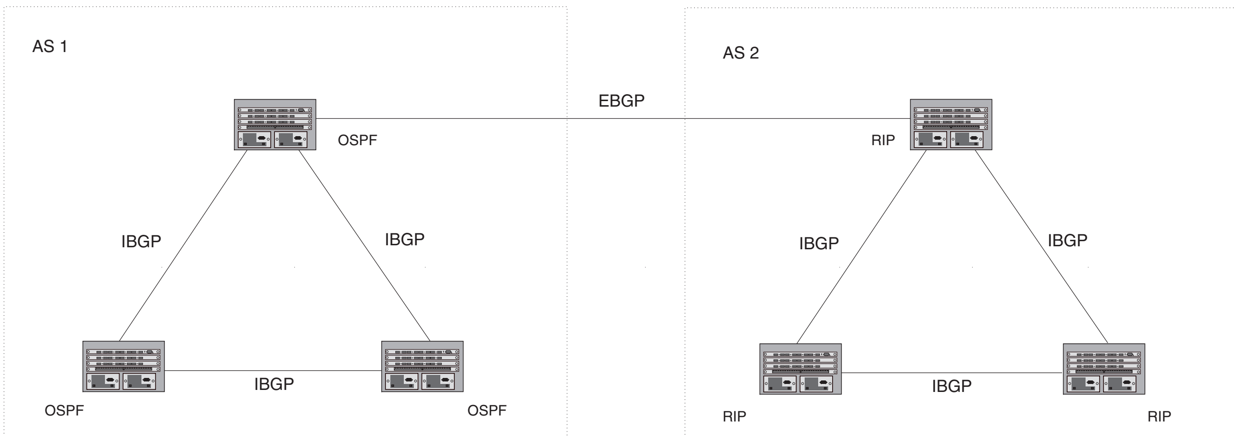


Figure 10.1 Example BGP4 ASs

Relationship Between the BGP4 Route Table and the IP Route Table

The HP routing switch's BGP4 route table can have multiple routes to the same destination, which are learned from different BGP4 neighbors. A BGP4 neighbor is another router that also is running BGP4. BGP4 neighbors communicate using Transmission Control Protocol (TCP) port 179 for BGP communication. When you configure the HP routing switch for BGP4, one of the configuration tasks you perform is to identify the routing switch's BGP4 neighbors.

Although a router's BGP4 route table can have multiple routes to the same destination, the BGP4 protocol evaluates the routes and chooses only one of the routes to send to the IP route table. The route that BGP4 chooses and sends to the IP route table is the ***preferred route*** and will be used by the HP routing switch. If the preferred route goes down, BGP4 updates the route information in the IP route table with a new BGP4 preferred route.

NOTE: If IP load sharing is enabled and you enable multiple equal-cost paths for BGP4, BGP4 can select more than one equal-cost path to a destination.

A BGP4 route consists of the following information:

- Network number (prefix) – A value comprised of the network mask bits and an IP address (<IP address>/ <mask bits>); for example, 192.215.129.0/18 indicates a network mask of 18 bits applied to the IP address 192.215.129.0. When a BGP4 routing switch advertises a route to one of its neighbors, the route is expressed in this format.
- AS-path – A list of the other ASs through which a route passes. BGP4 routers can use the AS-path to detect and eliminate routing loops. For example, if a route received by a BGP4 router contains the AS that the router is in, the router does not add the route to its own BGP4 table. (The BGP4 RFCs refer to the AS-path as

"AS_PATH".)

- Additional path attributes – A list of additional parameters that describe the route. The route origin and next hop are examples of these additional path attributes.

NOTE: The routing switch re-advertises a learned best BGP4 route to the routing switch's neighbors even when the software does not also select that route for installation in the IP route table. The best BGP4 route is the BGP4 path that the software selects based on comparison of the paths' BGP4 route parameters.

After an HP routing switch successfully negotiates a BGP4 session with a neighbor (a BGP4 peer), the HP routing switch exchanges complete BGP4 route tables with the neighbor. After this initial exchange, the HP routing switch and all other RFC 1771-compliant BGP4 routers send UPDATE messages to inform neighbors of new, changed, or no longer feasible routes. BGP4 routers do not send regular updates. However, if configured to do so, a BGP4 router does regularly send KEEPALIVE messages to its peers to maintain BGP4 sessions with them if the router does not have any route information to send in an UPDATE message. See "BGP4 Message Types" on page 10-4 for information about BGP4 messages.

How BGP4 Selects a Path for a Route

When multiple paths for the same route are known to a BGP4 router, the router uses an algorithm to weigh the paths and determine the optimal path for the route. The optimal path depends on various parameters including the following. You can modify some of these parameters. (See "Optional Configuration Tasks" on page 10-23.)

- Weight – A value that the HP BGP4 routing switch associates with a specific BGP4 neighbor. For example, if the routing switch receives routes to the same destination from two BGP4 neighbors, the routing switch prefers the route from the neighbor with the larger weight.
- Local preference – An attribute that indicates a degree of preference for a route relative to other routes in the local AS.
- AS-path length – The number of ASs through which the route must pass to reach the destination. The AS-path is a sequential list of the AS numbers through which the route information has passed to reach the BGP4 routing switch.
- Origin – The source of the route information. The origin can be IGP, EGP, or INCOMPLETE. IGP is preferred over EGP and both are preferred over INCOMPLETE.
- Multi-Exit Discriminator (MED) – A value associated with routes that have multiple paths through the same AS. In BGP4, a route's MED is equivalent to its "metric".
- Confederation membership.
- Closest IBGP neighbor – The closest internal path to the destination within the local AS.
- Number of paths available for load sharing.

HP routing switches use the following algorithm to choose the optimal path for a BGP4 route. The algorithm uses the parameters listed above.

1. Is the next hop accessible though an Interior Gateway Protocol (IGP) route? If not, ignore the route.
2. Use the path with the largest weight.
3. If the weights are the same, prefer the route with the largest local preference.
4. If the routes have the same local preference, prefer the route that was originated locally (by this BGP4 routing switch).
5. If the local preferences are the same and the routes were originated locally, prefer the route with the shortest AS-path. All paths within a confederation have the same length.
6. If the AS-path lengths are the same, prefer the route with the lowest origin type. From low to high, route origin types are valued as follows:
   - IGP is lowest
   - EGP is higher than IGP but lower than INCOMPLETE

- INCOMPLETE is highest

7. If the routes have the same origin type, prefer the route with the lowest MED.

NOTE: If the path does not have the MED attribute, HP's BGP4 uses zero as the MED value for the comparison.

8. If the routes have the same MED, prefer routes in the following order:
   - Routes received through EBGP from a BGP neighbor outside of the confederation
   - Routes received through EBGP from a BGP router within the confederation
   - Routes received through IBGP
9. If all the comparisons above are equal, prefer the route that can be reached using the closest IGP neighbor. This is the closest internal path inside the AS to reach the destination.
10. If the internal paths also are the same, prefer the route that comes from the BGP4 router with the lowest router ID.

NOTE: HP routing switches support BGP4 load sharing among multiple equal-cost paths. BGP4 load sharing enables the routing switch to balance the traffic across the multiple paths instead of choosing just one path based on router ID. See "Changing the Maximum Number of Paths for BGP4 Load Sharing" on page 10-25 for more information.

BGP4 Message Types

BGP4 routers communicate with their neighbors (other BGP4 routers) using the following types of messages:

- OPEN
- UPDATE
- KEEPALIVE
- NOTIFICATION

OPEN Message

After a BGP4 router establishes a TCP connection with a neighboring BGP4 router, the routers exchange OPEN messages. An OPEN message indicates the following:

- BGP version – Indicates the version of the protocol that is in use on the router. BGP version 4 supports Classless Interdomain Routing (CIDR) and is the version most widely used in the Internet. Version 4 also is the only version supported on HP routing switches.
- AS number – A two-byte number that identifies the AS to which the BGP4 router belongs.
- Hold Time – The number of seconds a BGP4 router will wait for an UPDATE or KEEPALIVE message (described below) from a BGP4 neighbor before assuming that the neighbor is dead. BGP4 routers exchange UPDATE and KEEPALIVE messages to update route information and maintain communication. If BGP4 neighbors are using different Hold Times, the lowest Hold Time is used by the neighbors. If the Hold Time expires, the BGP4 router closes its TCP connection to the neighbor and clears any information it has learned from the neighbor and cached.

  You can configure the Hold Time to be 0, in which case a BGP4 router will consider its neighbors to always be up. For directly-attached neighbors, you can configure the HP routing switch to immediately close the TCP connection to the neighbor and clear entries learned from an EBGP neighbor if the interface to that neighbor goes down. This capability is provided by the fast external fallover feature, which is disabled by default.
- BGP Identifier – The router ID. The BGP Identifier (router ID) identifies the BGP4 router to other BGP4 routers. HP routing switches use the same router ID for OSPF and BGP4. If you do not set a router ID, the software uses the IP address on the lowest numbered loopback interface configured on the router. If the

routing switch does not have a loopback interface, the default router ID is the lowest numbered IP address configured on the device. For more information or to change the router ID, see “Changing the Router ID” on page 6-25.

- Parameter list – An optional list of additional parameters used in peer negotiation with BGP4 neighbors.

UPDATE Message

After BGP4 neighbors establish a BGP4 connection over TCP and exchange their BGP4 routing tables, they do not send periodic routing updates. Instead, a BGP4 neighbor sends an update to its neighbor when it has a new route to advertise or routes have changed or become unfeasible. An UPDATE message can contain the following information:

- Network Layer Reachability Information (NLRI) – The mechanism by which BGP4 supports Classless Interdomain Routing (CIDR). An NLRI entry consists of an IP prefix that indicates a network being advertised by the UPDATE message. The prefix consists of an IP network number and the length of the network portion of the number. For example, an UPDATE message with the NLRI entry 192.215.129.0/18 indicates a route to IP network 192.215.129.0 with network mask 255.255.192.0. The binary equivalent of this mask is 18 consecutive one bits, thus “18” in the NLRI entry.
- Path attributes – Parameters that indicate route-specific information such as path information, route preference, next hop values, and aggregation information. BGP4 uses the path attributes to make filtering and routing decisions.
- Unreachable routes – A list of routes that have been in the sending router’s BGP4 table but are no longer feasible. The UPDATE message lists unreachable routes in the same format as new routes:
<IP address>/<CIDR prefix>.

KEEPALIVE Message

BGP4 routers do not regularly exchange UPDATE messages to maintain the BGP4 sessions. For example, if an HP 9308M configured to perform BGP4 routing has already sent the latest route information to its peers in UPDATE messages, the router does not send more UPDATE messages. Instead, BGP4 routers send KEEPALIVE messages to maintain the BGP4 sessions. KEEPALIVE messages are 19 bytes long and consist only of a message header; they contain no routing data.

BGP4 routers send KEEPALIVE messages at a regular interval, the Keep Alive Time. The default Keep Alive Time on HP routing switches is 60 seconds.

A parameter related to the Keep Alive Time is the Hold Time. A BGP4 router’s Hold Time determines how many seconds the router will wait for a KEEPALIVE or UPDATE message from a BGP4 neighbor before deciding that the neighbor is dead. The Hold Time is negotiated when BGP4 routers exchange OPEN messages; the lower Hold Time is then used by both neighbors. For example, if BGP4 Router A sends a Hold Time of 5 seconds and BGP4 Router B sends a Hold Time of 4 seconds, both routers use 4 seconds as the Hold Time for their BGP4 session. The default Hold Time is 180 seconds. Generally, the Hold Time is configured to three times the value of the Keep Alive Time.

If the Hold Time is 0, a BGP4 router assumes that its neighbor is alive regardless of how many seconds pass between receipt of UPDATE or KEEPALIVE messages.

NOTIFICATION Message

When you close the router’s BGP4 session with a neighbor, or the router detects an error in a message received from the neighbor, or an error occurs on the router, the router sends a NOTIFICATION message to the neighbor. No further communication takes place between the BGP4 router that sent the NOTIFICATION and the neighbor(s) that received the NOTIFICATION.

Basic Configuration and Activation for BGP4

BGP4 is disabled by default. To enable BGP4 and place your HP routing switch into service as a BGP4 router, you must perform at least the following steps:

1. Enable the BGP4 protocol.
2. Set the local AS number.

   NOTE: You must specify the local AS number. BGP4 is not functional until you specify the local AS number.

3. Add each BGP4 neighbor (peer BGP4 router) and identify the AS the neighbor is in.
4. Save the BGP4 configuration information to the system configuration file.

NOTE: By default, the HP router ID is the IP address configured on the lowest numbered loopback interface. If the routing switch does not have a loopback interface, the default router ID is the lowest numbered IP address configured on the device. For more information or to change the router ID, see “Changing the Router ID” on page 6-25. If you change the router ID, all current BGP4 sessions are cleared.

USING THE CLI

NOTE: This procedure shows a command prompt for an HP 9308M, but the same steps apply to any HP routing switch that supports BGP4.

```
HP9300> enable
HP9300# configure terminal
HP9300(config)# router bgp
BGP4: Please configure 'local-as' parameter in order to enable BGP4.
HP9300(config-bgp-router)# local-as 10
HP9300(config-bgp-router)# neighbor 209.157.23.99 remote-as 100
HP9300(config-bgp-router)# write memory
```

NOTE: When BGP4 is enabled on an HP routing switch, you do not need to reset the system. The protocol is activated as soon as you enable it. Moreover, the router begins a BGP4 session with a BGP4 neighbor as soon as you add the neighbor.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Select the Enable radio button next to BGP.
3. Enter the local AS number in the Local AS field.
4. Click the Apply button to apply the changes to the device’s running-config file.
5. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Note Regarding Disabling BGP4

If you disable BGP4, the routing switch removes all the configuration information for the disabled protocol from the running-config. Moreover, when you save the configuration to the startup-config file after disabling one of these protocols, all the configuration information for the disabled protocol is removed from the startup-config file.

The CLI displays a warning message such as the following:

```
HP9300(config-bgp-router)# no router bgp
router bgp mode now disabled. All bgp config data will be lost when writing to
flash!
```

The Web management interface does not display a warning message.

If you have disabled the protocol but have not yet saved the configuration to the startup-config file and reloaded the software, you can restore the configuration information by re-entering the command to enable the protocol (ex: **router bgp**), or by selecting the Web management option to enable the protocol. If you have already saved the configuration to the startup-config file, the information is gone.

If you are testing a BGP4 configuration and are likely to disable and re-enable the protocol, you might want to make a backup copy of the startup-config file containing the protocol's configuration information. This way, if you remove the configuration information by saving the configuration after disabling the protocol, you can restore the configuration by copying the backup copy of the startup-config file onto the flash memory.

NOTE: Another way to disable BGP4 is to remove the local AS (for example, by entering the **no local-as** <num> command). In this case, BGP4 retains the other configuration information but is not operational until you set the local AS again.

BGP4 Parameters

You can modify or set the following BGP4 parameters.

- Optional – Define the router ID. (The same router ID also is used by OSPF.)
- Required – Specify the local AS number.
- Optional – Add a loopback interface for use with neighbors.
- Required – Identify BGP4 neighbors.
- Optional – Change the Keep Alive Time and Hold Time.
- Optional – Enable fast external fallover.
- Optional – Specify a list of individual networks in the local AS to be advertised to remote ASs using BGP4.
- Optional – Change the default local preference for routes.
- Optional – Change the default information originate.
- Optional – Change the default MED (metric).
- Optional – Change the default administrative distances for EBGP, IBGP, and locally originated routes.
- Optional – Always compare MEDs (metrics) when choosing a route.
- Optional – Enable synchronization of routes between BGP4 and IGP.
- Optional – Enable auto summary to summarize routes at an IP class boundary (A, B, or C).
- Optional – Aggregate routes in the BGP4 route table into CIDR blocks.
- Optional – Configure the router as a BGP4 router reflector.
- Optional – Configure the routing switch as a member of a BGP4 confederation.
- Optional – Change the default metric for routes that BGP4 redistributes into RIP or OSPF.
- Optional – Change the parameters for RIP, OSPF, or static routes redistributed into BGP4.
- Optional – Change the number of paths for BGP4 load sharing.
- Optional – Define BGP4 address filters.
- Optional – Define BGP4 AS-path filters.
- Optional – Define BGP4 community filters.

- Optional – Define IP prefix lists.
- Optional – Define neighbor distribute lists.
- Optional – Define BGP4 route maps for filtering routes redistributed into RIP and OSPF.
- Optional – Define route flap dampening parameters.

NOTE: When using CLI, you set global level parameters at the BGP CONFIG Level of the CLI. You can reach the BGP CONFIG level by entering **router bgp…** at the global CONFIG level.

NOTE: When using the Web management interface, you set BGP4 global parameters using the BGP configuration panel, shown in Figure 10.2 on page 10-8. You can access all other parameters using links on the BGP configuration panel or from the Configure->BGP options in the tree view. Select Configure->BGP-General to display the BGP configuration panel.

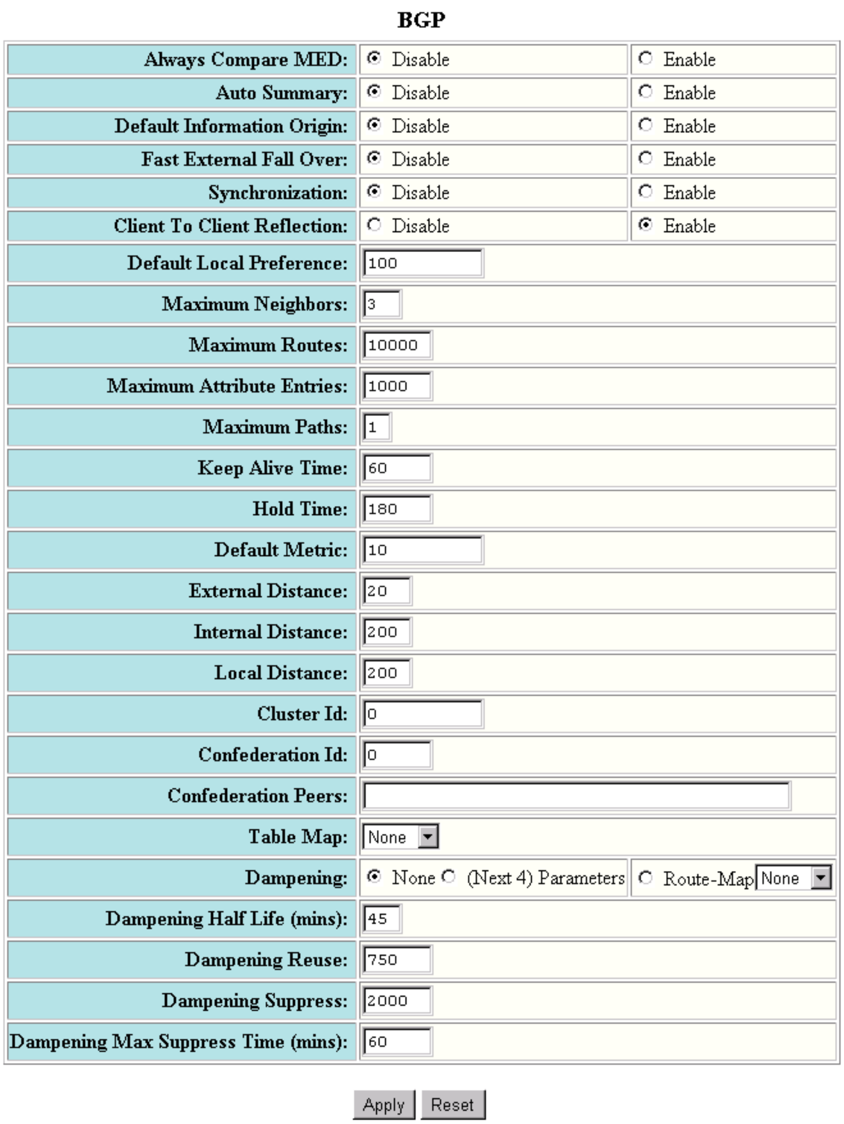


Figure 10.2 BGP configuration panel

When Parameter Changes Take Effect

Some parameter changes take effect immediately while others do not take full effect until the router's sessions with its neighbors are closed, then restarted. Some parameters do not take effect until the router is rebooted.

Immediately

The following parameter changes take effect immediately:

- Enable or disable BGP.
- Set or change the local AS.
- Add neighbors.
- Disable or enable fast external fallover.
- Specify individual networks that can be advertised.
- Change the default local preference, default information originate, or administrative distance.
- Enable or disable MED (metric) comparison.
- Disable or enable IGP and BGP4 synchronization.
- Enable or disable auto summary.
- Change the default metric.
- Disable or re-enable route reflection.
- Configure confederation parameters.
- Disable or re-enable load sharing.
- Change the maximum number of load-sharing paths.
- Define route flap dampening parameters.
- Add, change, or negate redistribution parameters (except changing the default MED; see below).

After Resetting Neighbor Sessions

The following parameter changes take effect only after the router's BGP4 sessions are cleared, or reset using the "soft" clear option. (See "Closing or Resetting a Neighbor Session" on page 10-116.)

- Change the Hold Time or Keep Alive Time.
- Aggregate routes.
- Add, change, or negate filter tables.
- Add, change, or negate route maps.

After Disabling and Re-Enabling Redistribution

The following parameter change takes effect only after you disable and then re-enable redistribution:

- Change the default MED (metric).

Memory Considerations

BGP4 handles a very large number of routes and therefore requires a lot of memory. For example, in a typical configuration with just a single BGP4 neighbor, a BGP4 router may need to be able to hold up to 80,000 routes. Many configurations, especially those involving more than one neighbor, can require the router to hold even more routes. HP routing switches and NAs provide dynamic memory allocation for BGP4 data. These devices automatically allocate memory when needed to support BGP4 neighbors, routes, and route attribute entries. Dynamic memory allocation is performed automatically by the software and does not require a reload.

Table 10.1 lists the maximum total amount of system memory (DRAM) BGP4 can use in software release 07.1.*X*. The maximum depends on the total amount of system memory on the device.

Table 10.1: Maximum Memory Usage

Platform	Maximum Memory BGP4 Can Use
Management module with 32 MB **Note**: This amount also applies to HP 6308M-SX routing switches with 32 MB.	7 MB
Redundant Management module with 128 MB	62 MB

The memory amounts listed in the table are for all BGP4 data, including routes received from neighbors, BGP route advertisements (routes sent to neighbors), and BGP route attribute entries. The routes sent to and received from neighbors use the most BGP4 memory. Generally, the actual limit to the number of neighbors, routes, or route attribute entries the device can accommodate depends on how many routes the routing switch sends to and receives from the neighbors.

In some cases, where most of the neighbors do not send or receive a full BGP route table (about 80,000 routes), the memory can support a larger number of BGP4 neighbors. However, if most of the BGP4 neighbors send or receive full BGP route tables, the number of BGP neighbors the memory can support is less than in configurations where the neighbors send smaller route tables.

Memory Configuration Options Obsoleted by Dynamic Memory

Devices that support dynamic BGP4 memory allocation do not require or even support static configuration of memory for BGP4 neighbors, routes, or route attributes. Consequently, the following CLI commands and equivalent Web management options are not supported on these devices:

- **max-neighbors** <num>
- **max-routes** <num>
- **max-attribute-entries** <num>

If you boot a device that has a startup-config file that contains these commands, the software ignores the commands and uses dynamic memory allocation for BGP4. The first time you save the device's running configuration (running-config) to the startup-config file, the commands are removed from the file.

Configuring BGP4

To begin using BGP4 on the routing switch, follow the steps outlined below:

1. Optionally define the router ID.
2. Enable the BGP4 feature on the routing switch.
3. Set the local AS number.
4. Identify the HP routing switch's BGP4 neighbors and the ASs they are in.
5. Optionally change the Keep Alive Time and Hold TIme.
6. Optionally enable fast external fallover.
7. Optionally change the maximum number of BGP4 load sharing paths.
8. Optionally specify a list of individual networks in the local AS to be advertised to remote ASs using BGP4.
9. Optionally change the default local preference, default information originate, default MED (metric), or administrative distances. (You change these parameters independently of one another.)
10. Optionally configure the routing switch to always compare MEDs (metrics) when choosing a route.
11. Optionally enable synchronization of routes between BGP4 and IGP.

12. Optionally enable automatic summarization of subnets at the classical IP boundaries (classes A, B, and C).
13. Optionally aggregate routes in the BGP4 route table into CIDR blocks.
14. Optionally configure the routing switch as a BGP4 route reflector.
15. Optionally configure the routing switch as a member of a BGP4 confederation.
16. Optionally change the default metric for routes that BGP4 redistributes into RIP or OSPF.
17. Optionally define BGP4 address filters, AS-path filters, or community filters.
18. Optionally define IP prefix lists.
19. Optionally define neighbor distribute lists.
20. Optionally define BGP4 route map entries.
21. Optionally define route flap dampening parameters.
22. Save the changes to flash memory.

Basic Configuration Tasks

The following sections describe how to perform the configuration tasks that are required to use BGP4 on the HP routing switch. You can modify many parameters in addition to the ones described in this section. See “Optional Configuration Tasks” on page 10-23.

Enabling BGP4 on the Routing Switch

When you enable BGP4 on the routing switch, BGP4 is automatically activated. To enable BGP4 on the routing switch, enter the following commands:

USING THE CLI

```
HP9300> enable
HP9300# configure terminal
HP9300(config)# router bgp
BGP4: Please configure ’local-as’ parameter in order to enable BGP4.
HP9300(config-bgp-router)# local-as 10
HP9300(config-bgp-router)# neighbor 209.157.23.99 remote-as 100
HP9300(config-bgp-router)# write memory
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Select the Enable radio button next to BGP.
3. Enter the local AS number in the Local AS field.
4. Click the Apply button to apply the changes to the device’s running-config file.
5. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Changing the Router ID

The OSPF and BGP4 protocols use router IDs to identify the routers that are running the protocols. A router ID is a valid, unique IP address and sometimes is an IP address configured on the router. The router ID cannot be an IP address in use by another device.

By default, the router ID on an HP routing switch is one of the following:

- If the routing switch has loopback interfaces, the default router ID is the IP address configured on the lowest numbered loopback interface configured on the routing switch. For example, if you configure loopback interfaces 1, 2, and 3 as follows, the default router ID is 9.9.9.9/24:

- Loopback interface 1, 9.9.9.9/24
- Loopback interface 2, 4.4.4.4/24
- Loopback interface 3, 1.1.1.1/24

- If the device does not have any loopback interfaces, the default router ID is the lowest numbered IP interface configured on the device, as in earlier software releases.

NOTE: HP routing switches use the same router ID for both OSPF and BGP4. If the routing switch is already configured for OSPF, you may want to use the router ID that is already in use on the routing switch rather than set a new one. To display the router ID, enter the **show ip** CLI command at any CLI level or select the IP->General links from the Configure tree in the Web management interface.

USING THE CLI

To change the router ID, enter a command such as the following:

```
HP9300(config)# ip router-id 209.157.22.26
```

Syntax: ip router-id <ip-addr>

The <ip-addr> can be any valid, unique IP address.

NOTE: You can specify an IP address used for an interface on the HP routing switch, but do not specify an IP address in use by another device.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the General link to display the IP configuration panel.
5. Edit the value in the Router ID field. Specify a valid IP address that is not in use on another device in the network.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Setting the Local AS Number

The local AS number identifies the AS the HP BGP4 router is in. The AS number can be from 1 – 65535. There is no default. AS numbers 64512 – 65535 are the well-known private BGP4 AS numbers and are not advertised to the Internet community.

To set the local AS number, use either of the following methods.

USING THE CLI

To set the local AS number, enter commands such as the following:

```
HP9300(config)# router bgp
BGP4: Please configure 'local-as' parameter in order to enable BGP4.
HP9300(config-bgp-router)# local-as 10
HP9300(config-bgp-router)# write memory
```

Syntax: [no] local-as <num>

The <num> parameter specifies the local AS number.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Select the Enable radio button next to BGP.
3. Enter the local AS number in the Local AS field.
4. Click the Apply button to apply the changes to the device's running-config file.
5. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Adding a Loopback Interface

You can configure the routing switch to use a loopback interface instead of a specific port to communicate with a BGP4 neighbor. A loopback interface adds stability to the network by working around route flap problems that can occur due to unstable links between the routing switch and its neighbors.

Loopback interfaces are always up, regardless of the states of physical interfaces. Loopback interfaces are especially useful for IBGP neighbors (neighbors in the same AS) that are multiple hops away from the routing switch. When you configure a BGP4 neighbor on the routing switch, you can specify whether the routing switch uses the loopback interface to communicate with the neighbor. As long as a path exists between the routing switch and its neighbor, BGP4 information can be exchanged. The BGP4 session is not associated with a specific link but instead is associated with the virtual interfaces.

You can add up to 24 IP addresses to each loopback interface.

NOTE: If you configure the HP routing switch to use a loopback interface to communicate with a BGP4 neighbor, the peer IP address on the remote router pointing to your loopback address must be configured.

To add a loopback interface, use one of the following methods.

USING THE CLI

To add a loopback interface, enter commands such as those shown in the following example:

```
HP9300(config-bgp-router)# exit
HP9300(config)# int loopback 1
HP9300(config-lbif-1)# ip address 10.0.0.1/24
```

Syntax: interface loopback <num>

The <num> value can be from 1 – 8 on the HP 9308M, HP 9304M, and HP 6308M-SX. The value can be from 1 – 4 on the HP6308.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Select the IP Address link to display a table listing the configured IP addresses.
3. Select the Loop Back link.

   NOTE: If the device already has loopback interfaces, a table listing the interfaces is displayed. Click the Modify button to the right of the row describing an interface to change its configuration, or click the Add Loop Back link to display the Router Loop Back configuration panel.

4. Select the loopback interface number from the Loopback field's pulldown menu. You can select from 1 – 8.
5. Select the status. The interface is enabled by default.
6. Click Add to add the new interface.

7. Click on Configure in the tree view to display the configuration options.
8. Click on IP to display the IP configuration options.
9. Select the Add IP Address link to display the Router IP Address panel.
10. Select the loopback interface from the Port field's pulldown menu. For example, to select loopback interface 1, select "lb1". (If you are configuring a Chassis device, you can have any slot number in the Slot field. Loopback interfaces are not associated with particular slots or physical ports.)
11. Enter the loopback interface's IP address in the IP Address field.
12. Enter the network mask in the Subnet Mask field.
13. Click the Add button to save the change to the device's running-config file.
14. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Adding BGP4 Neighbors

The BGP4 protocol does not contain a peer discovery process. Therefore, for each of the routing switch's BGP4 neighbors (peers), you must indicate the neighbor's IP address and the AS each neighbor is in. Neighbors that are in different ASs communicate using EBGP. Neighbors within the same AS communicate using IBGP.

NOTE: If the routing switch has multiple neighbors with similar attributes, you can simplify configuration by configuring a peer group, then adding individual neighbors to it. The configuration steps are similar, except you specify a peer group name instead of a neighbor IP address when configuring the neighbor parameters, then add individual neighbors to the peer group. See "Adding a BGP4 Peer Group" on page 10-19.

NOTE: The routing switch attempts to establish a BGP4 session with a neighbor as soon as you enter a command specifying the neighbor's IP address. If you want to completely configure the neighbor parameters before the routing switch establishes a session with the neighbor, you can administratively shut down the neighbor. See "Administratively Shutting Down a Session with a BGP4 Neighbor" on page 10-22.

USING THE CLI

To add a BGP4 neighbor with IP address 209.157.22.26, enter the following command:

```
HP9300(config-bgp-router)# neighbor 209.157.22.26
```

The neighbor's <ip-addr> must be a valid IP address.

The **neighbor** command has some additional parameters, as shown in the following syntax:

Syntax: [no] neighbor <ip-addr> | <peer-group-name>
[advertisement-interval <num>] [default-originate [route-map <map-name>]]
[description <string>]
[distribute-list in | out <num,num,...> | <acl-num> in | out]
[ebgp-multihop [<num>]]
[filter-list in | out <num,num,...> | <acl-num> in | out | weight]
[maximum-prefix <num>] [next-hop-self]
[password <string>] [prefix-list <string>]
[remote-as <as-number>] [remove-private-as]
[route-map in | out <map-name>] [route-reflector-client]
[send-community] [shutdown] [timers keep-alive <num> hold-time <num>]
[update-source loopback <num>] [weight <num>]

The <ip-addr> | <peer-group-name> parameter indicates whether you are configuring an individual neighbor or a peer group. If you specify a neighbor's IP address, you are configuring that individual neighbor. If you specify a peer group name, you are configuring a peer group. See "Adding a BGP4 Peer Group" on page 10-19.

advertisement-interval <num> specifies the minimum delay (in seconds) between messages to the specified neighbor. The default is 30 for EBGP neighbors (neighbors in other ASs). The default is 5 for IBGP neighbors (neighbors in the same AS). The range is 0 – 600.

NOTE: The routing switch applies the advertisement interval only under certain conditions. The routing switch does not apply the advertisement interval when sending initial updates to a BGP4 neighbor. As a result, the routing switch sends the updates one immediately after another, without waiting for the advertisement interval.

---

default-originate [**route-map** <map-name>] configures the routing switch to send the default route 0.0.0.0 to the neighbor. If you use the route-map <map-name> parameter, the route map injects the default route conditionally, based on the match conditions in the route map.

description <string> specifies a name for the neighbor. You can enter an alphanumeric text string up to 80 characters long.

distribute-list in | out <num,num,...> specifies a distribute list to be applied to updates to or from the specified neighbor. The **in | out** keyword specifies whether the list is applied on updates received from the neighbor or sent to the neighbor. The <num,num,...> parameter specifies the list of address-list filters. The routing switch applies the filters in the order in which you list them and stops applying the filters in the distribute list when a match is found.

Alternatively, you can specify **distribute-list** <acl-num> **in | out** to use an IP ACL instead of a distribute list. In this case, <acl-num> is an IP ACL.

NOTE: By default, if a route does not match any of the filters, the routing switch denies the route. To change the default behavior, configure the last filter as “permit any any”.

NOTE: The address filter must already be configured. See “Filtering Specific IP Addresses” on page 10-44.

---

ebgp-multihop [<num>] specifies that the neighbor is more than one hop away and that the session type with the neighbor is thus EBGP-multihop. This option is disabled by default. The <num> parameter specifies the TTL you are adding for the neighbor. You can specify a number from 0 – 255. The default is 0. If you leave the EBGP TTL value set to 0, the software uses the IP TTL value.

filter-list in | out <num,num,...> specifies an AS-path filter list or a list of AS-path Access Control Lists (ACLs). The **in | out** keyword specifies whether the list is applied on updates received from the neighbor or sent to the neighbor. If you specify **in** or **out**, The <num,num,...> parameter specifies the list of AS-path filters. The routing switch applies the filters in the order in which you list them and stops applying the filters in the AS-path filter list when a match is found. The **weight** <num> parameter specifies a weight that the routing switch applies to routes received from the neighbor that match the AS-path filter or ACL. You can specify a number from 0 – 65535.

Alternatively, you can specify **filter-list** <acl-num> **in | out | weight** to use an AS-path ACL instead of an AS-path filter list. In this case, <acl-num> is an AS-path ACL.

NOTE: By default, if an AS-path does not match any of the filters or ACLs, the routing switch denies the route. To change the default behavior, configure the last filter or ACL as “permit any any”.

NOTE: The AS-path filter or ACL must already be configured. See “Filtering AS-Paths” on page 10-46.

---

maximum-prefix <num> specifies the maximum number of IP network prefixes (routes) that can be learned from the specified neighbor. The default is 0 (unlimited). You can configure a value from 0 – 4294967295.

next-hop-self specifies that the routing switch should list itself as the next hop in updates sent to the specified neighbor. This option is disabled by default.

password <string> specifies an MD5 password for securing sessions between the routing switch and the neighbor. You can enter a string up to 80 characters long. The string can contain any alphanumeric characters, but the first character cannot be a number. If the password contains a number, do not enter a space following the number.

prefix-list <string> specifies an IP prefix list. You can use IP prefix lists to control routes to and from the neighbor. IP prefix lists are an alternative method to AS-path filters. You can configure up to 1000 prefix list filters. The filters can use the same prefix list or different prefix lists. To configure an IP prefix list, see "Defining IP Prefix Lists" on page 10-55.

remote-as <as-number> specifies the AS the remote neighbor is in. The <as-number> can be a number from 1 – 65535. There is no default.

remove-private-as configures the routing switch to remove private AS numbers from UPDATE messages the routing switch sends to this neighbor. The routing switch will remove AS numbers 64512 – 65535 (the well-known BGP4 private AS numbers) from the AS-path attribute in UPDATE messages the routing switch sends to the neighbor. This option is disabled by default.

route-map in | out <map-name> specifies a route map the routing switch will apply to updates sent to or received from the specified neighbor. The **in | out** keyword specifies whether the list is applied on updates received from the neighbor or sent to the neighbor.

NOTE: The route map must already be configured. See "Defining Route Maps" on page 10-59.

---

route-reflector-client specifies that this neighbor is a route-reflector client of the routing switch. Use the parameter only if this routing switch is going to be a route reflector. For information, see "Configuring Route Reflection Parameters" on page 10-33. This option is disabled by default.

send-community enables sending the community attribute in updates to the specified neighbor. By default, the routing switch does not send the community attribute.

shutdown administratively shuts down the session with this neighbor. Shutting down the session allows you to completely configure the neighbor and save the configuration without actually establishing a session with the neighbor. This option is disabled by default.

timers keep-alive <num> **hold-time** <num> overrides the global settings for the Keep Alive Time and Hold Time. For the Keep Alive Time, you can specify from 0 – 65535 seconds. For the Hold Time, you can specify 0 or 3 – 65535 (1 and 2 are not allowed). If you set the Hold Time to 0, the routing switch waits indefinitely for messages from a neighbor without concluding that the neighbor is dead. The defaults for these parameters are the currently configured global Keep Alive Time and Hold Time. For more information about these parameters, see "Changing the Keep Alive Time and Hold Time" on page 10-23.

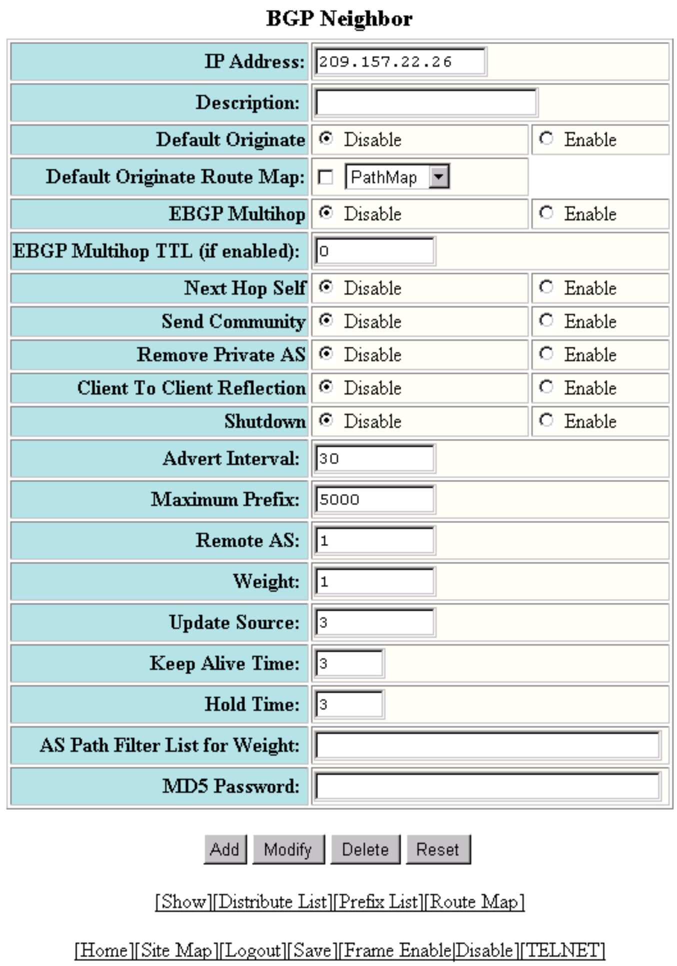
update-source loopback <num> configures the routing switch to communicate with the neighbor through the loopback address on the specified interface. Using a loopback address for neighbor communication avoids problems that can be caused by unstable routing switch interfaces. Generally, loopback interfaces are used for links to IBGP neighbors, which often are multiple hops away, rather than EBGP neighbors. The <num> parameter indicates the loopback interface number and can be from 1 – 4. There is no default.

weight <num> specifies a weight the routing switch will add to routes received from the specified neighbor. BGP4 prefers larger weights over smaller weights. The default weight is 0.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Neighbor link to display the BGP Neighbor panel.

NOTE: If the device already has neighbors, a table listing the neighbors is displayed. Click the Modify button to the right of the row describing the neighbor to change its configuration, or click the Add Neighbor link to display the BGP Neighbor configuration panel.



1. Enter the neighbor's IP address in the IP Address field.
2. Enter a description in the Description field.
3. Select Enable next to Default Originate if you want to enable this feature for the neighbor. By default, the routing switch does not advertise a default route using BGP4. A BGP4 default route is the IP address 0.0.0.0 and the route prefix 0 or network mask 0.0.0.0. For example, 0.0.0.0/0 is a default route.
4. Select the checkbox next to Default Originate Route Map and select a route map from the pulldown menu if you want to use a route map to control advertisement of default routes.
5. Select Enable next to EBGP Multihop if the neighbor is multiple EBGP hops away.
6. If you enabled EBGP Multihop, enter the TTL for EBGP multihop in the EBGP Multihop TTL field. You can specify a number from 0 – 255. The default is 0. If you leave the EBGP TTL value set to 0, the software uses the IP TTL value.
7. Select Enable next to Next Hop Self if the routing switch should list itself as the next hop in updates sent to the neighbor. This option is disabled by default.
8. Select Enable next to Send Community if you want to send the community attribute in updates to the neighbor. By default, the routing switch does not send the community attribute.
9. Select Enable next to Remove Private AS if you want the routing switch to remove private AS numbers from UPDATE messages the routing switch sends to this neighbor. The routing switch will remove AS numbers 64512 – 65535 (the well-known BGP4 private AS numbers) from the AS-path attribute in UPDATE messages the routing switch sends to the neighbor. This option is disabled by default.

10. Select Enable next to Client To Client Reflection if this neighbor is a route-reflector client of the routing switch. Use the parameter only if this routing switch is going to be a route reflector. For information, see “Configuring Route Reflection Parameters” on page 10-33. This option is disabled by default.
11. Select Enable next to Shutdown if you want to administratively shut down the session with this neighbor. Shutting down the session allows you to completely configure the neighbor and save the configuration without actually establishing a session with the neighbor. This option is disabled by default.
12. Enter the advertisement interval in the Advert Interval field. This parameter specifies the minimum delay (in seconds) between messages to the specified neighbor. The default is 30 for EBGP neighbors (neighbors in other ASs). The default is 5 for IBGP neighbors (neighbors in the same AS). The range is 0 – 600.
13. Edit the value in the Maximum Prefix field to change the maximum prefix. The maximum prefix is the maximum number of IP network prefixes (routes) that can be learned from the specified neighbor. The default is 0 (unlimited). The range is 0 – 4294967295.
14. Enter the remote AS number in the Remote AS field. The remote AS number is the number of the AS the neighbor is in.
15. Enter the weight you want the routing switch to add to routes received from the specified neighbor. BGP4 prefers larger weights over smaller weights. The default weight is 0.
16. Enter the number of an update source loopback interface in the Update Source field. This parameter configures the routing switch to communicate with the neighbor through the loopback address on the specified interface. Using a loopback address for neighbor communication avoids problems that can be caused by unstable routing switch interfaces. Generally, loopback interfaces are used for links to IBGP neighbors, which often are multiple hops away, rather than EBGP neighbors. The loopback interface number can be from 1 – 8. There is no default.
17. Enter a Keep Alive time in the Keep Alive Time field. This parameter overrides the global BGP4 Keep Alive Time configured on the routing switch. You can specify from 0 – 65535 seconds. The default is the current global setting.
18. Enter a Hold Time in the Hold Time field. This parameter overrides the global BGP4 Hold Time configured on the routing switch. You can specify 0 or 3 – 65535 (1 and 2 are not allowed). If you set the Hold Time to 0, the routing switch waits indefinitely for messages from a neighbor without concluding that the neighbor is dead. The default is the current global setting.

   NOTE: Set the Hold Time to three times the value of the Keep Alive Time. For information about these parameters, see “Changing the Keep Alive Time and Hold Time” on page 10-23.

19. If you specified a weight in the Weight field, enter a list of AS Path filters in the AS Path Filter List for Weight field. The routing switch applies the filters in the order in which you list them and stops applying the filters in the AS-path filter list when a match is found.

   NOTE: By default, if an AS-path does not match any of the filters, the routing switch denies the route. To change the default behavior, configure the last filter as “permit any any”.

   NOTE: The AS-path filter must already be configured. See “Filtering AS-Paths” on page 10-46.

20. Enter a password in the MD5 Password field to secure the routing switch’s sessions with this neighbor.

   NOTE: You must configure the neighbor to use the same password.

21. Click the Add button (if you are adding a new neighbor) or the Modify button (if you are modifying a neighbor that is already configured) to apply the changes to the device’s running-config file.
22. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Adding a BGP4 Peer Group

A ***peer group*** is a set of BGP4 neighbors that share common parameters. Peer groups provide the following benefits:

- Simplified neighbor configuration – You can configure a set of neighbor parameters and then apply them to multiple neighbors. You do not need to individually configure the common parameters individually on each neighbor.
- Flash memory conservation – Using peer groups instead of individually configuring all the parameters for each neighbor requires fewer configuration commands in the startup-config file.

You can perform the following tasks on a peer-group basis.

- Reset neighbor sessions
- Perform soft-outbound resets (the routing switch updates outgoing route information to neighbors but does not entirely reset the sessions with those neighbors)
- Clear BGP message statistics
- Clear error buffers

Peer Group Parameters

You can set all neighbor parameters in a peer group. When you add a neighbor to the peer group, the neighbor receives all the parameter settings you set in the group, except parameter values you have explicitly configured for the neighbor. If you do not set a neighbor parameter in the peer group and the parameter also is not set for the individual neighbor, the neighbor uses the default value.

You can set the following neighbor parameters using a peer group:

- Advertisement interval
- Default-information-originate
- Description
- Distribute list
- EBGP multihop
- Filter list
- Maximum prefix
- Next-hop-self
- Password
- Prefix-list
- Remote AS
- Remove private AS
- Route map
- Route reflector client
- Send community
- Shutdown
- Timers
- Update source
- Weight

Configuration Rules

The following rules apply to peer group configuration:

- You must configure a peer group before you can add neighbors to the peer group.
- If you remove a parameter from a peer group, the value for that parameter is reset to the default for all the neighbors within the peer group, unless you have explicitly set that parameter on individual neighbors. In this case, the value you set on the individual neighbors applies to those neighbors, while the default value applies to neighbors for which you have not explicitly set the value.

  NOTE: If you enter a command to remove the remote AS parameter from a peer group, the software checks to ensure that the peer group does not contain any neighbors. If the peer group does contain neighbors, the software does not allow you to remove the remote AS. The software prevents removing the remote AS in this case so that the neighbors in the peer group that are using the remote AS do not lose connectivity to the routing switch.

- Once you add a neighbor to a peer group, you cannot configure the following outbound parameters (the parameters governing outbound traffic) for the neighbor.
  - Default-information-originate
  - Next-hop-self
  - Outbound route map
  - Outbound filter list
  - Outbound distribute list
  - Outbound prefix list
  - Remote AS, if configured for the peer group
  - Remove private AS
  - Route reflector client
  - Send community
  - Timers
  - Update source

  If you want to change an outbound parameter for an individual neighbor, you must first remove the neighbor from the peer group. In this case, you cannot re-add the neighbor to the same peer group, but you can add the neighbor to a different peer group. All the neighbors within a peer group must have the same values for the outbound parameters. To change an outbound parameter to the same value for all neighbors within a peer group, you can change the parameter on a peer-group basis. In this case, you do not need to remove the neighbors and change the parameter individually for each neighbor.

- If you add an outbound parameter to a peer group, that parameter is automatically applied to all neighbors within the peer group.
- When you add a neighbor to a peer group, the software removes any outbound parameters for that neighbor from the running configuration (running-config). As a result, when you save the configuration to the startup-config file, the file does not contain any outbound parameters for the individual neighbors you have placed in a peer group. The only outbound parameters the startup-config file contains for neighbors within a peer group are the parameters associated with the peer group itself. However, the running-config and the startup-config file can contain individual parameters listed in the previous section as well as the settings for those parameters within a peer group.

You can override neighbor parameters that do not affect outbound policy on an individual neighbor basis.

- If you do not specify a parameter for an individual neighbor, the neighbor uses the value in the peer group.
- If you set the parameter for the individual neighbor, that value overrides the value you set in the peer group.

- If you add a parameter to a peer group that already contains neighbors, the parameter value is applied to neighbors that do not already have the parameter explicitly set. If a neighbor has the parameter explicitly set, the explicitly set value overrides the value you set for the peer group.
- If you remove the setting for a parameter from a peer group, the value for that parameter changes to the default value for all the neighbors in the peer group that do not have that parameter individually set.

Configuring a Peer Group

To configure a BGP4 peer group, use either of the following methods.

USING THE CLI

To configure a peer group, enter commands such as the following at the BGP configuration level:

```
HP9300(config-bgp-router)# neighbor PeerGroup1 peer-group
HP9300(config-bgp-router)# neighbor PeerGroup1 description “EastCoast Neighbors”
HP9300(config-bgp-router)# neighbor PeerGroup1 remote-as 100
HP9300(config-bgp-router)# neighbor PeerGroup1 distribute-list out 1
```

The commands in this example configure a peer group called “PeerGroup1” and set the following parameters for the peer group:

- A description, “EastCoast Neighbors”
- A remote AS number, 100
- A distribute list for outbound traffic

The software applies these parameters to each neighbor you add to the peer group. You can override the description parameter for individual neighbors. If you set the description parameter for an individual neighbor, the description overrides the description configured for the peer group. However, you cannot override the remote AS and distribute list parameters for individual neighbors. Since these parameters control outbound traffic, the parameters must have the same values for all neighbors within the peer group.

Syntax: neighbor <peer-group-name> peer-group

The <peer-group-name> parameter specifies the name of the group and can be up to 80 characters long. The name can contain special characters and internal blanks. If you use internal blanks, you must use quotation marks around the name. For example, the command **neighbor “My Three Peers” peer-group** is valid, but the command **neighbor My Three Peers peer-group** is not valid.

Syntax: [no] neighbor <ip-addr> | <peer-group-name>
[advertisement-interval <num>] [default-originate [route-map <map-name>]]
[description <string>]
[distribute-list in | out <num,num,...> | <acl-num> in | out]
[ebgp-multihop [<num>]]
[filter-list in | out <num,num,...> | <acl-num> in | out | weight]
[maximum-prefix <num>] [next-hop-self]
[password <string>] [prefix-list <string>]
[remote-as <as-number>] [remove-private-as]
[route-map in | out <map-name>] [route-reflector-client]
[send-community] [shutdown] [timers keep-alive <num> hold-time <num>]
[update-source loopback <num>] [weight <num>]

The <ip-addr> | <peer-group-name> parameter indicates whether you are configuring a peer group or an individual neighbor. You can specify a peer group name or IP address with the **neighbor** command. If you specify a peer group name, you are configuring a peer group. If you specify a neighbor’s IP address, you are configuring that individual neighbor. Use the <ip-addr> parameter if you are configuring an individual neighbor instead of a peer group. See “Adding BGP4 Neighbors” on page 10-14.

The remaining parameters are the same ones supported for individual neighbors. See “Adding BGP4 Neighbors” on page 10-14.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure peer group parameters using the Web management interface.

Applying a Peer Group to a Neighbor

After you configure a peer group, you can add neighbors to the group. When you add a neighbor to a peer group, you are applying all the neighbor attributes specified in the peer group to the neighbor.

To add a neighbor to a peer group, use either of the following methods.

USING THE CLI

To add neighbors to a peer group, enter commands such as the following:

```
HP9300(config-bgp-router)# neighbor 192.168.1.12 peer-group PeerGroup1
HP9300(config-bgp-router)# neighbor 192.168.2.45 peer-group PeerGroup1
HP9300(config-bgp-router)# neighbor 192.168.3.69 peer-group PeerGroup1
```

The commands in this example add three neighbors to the peer group “PeerGroup1”. As members of the peer group, the neighbors automatically receive the neighbor parameter values configured for the peer group. You also can override the parameters (except parameters that govern outbound traffic) on an individual neighbor basis. For neighbor parameters not specified for the peer group, the neighbors use the default values.

Syntax: neighbor <ip-addr> peer-group <peer-group-name>

The <ip-addr> parameter specifies the IP address of the neighbor.

The <peer-group-name> parameter specifies the peer group name.

NOTE: You must add the peer group before you can add neighbors to it.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure peer group parameters using the Web management interface.

Administratively Shutting Down a Session with a BGP4 Neighbor

You can prevent the routing switch from starting a BGP4 session with a neighbor by administratively shutting down the neighbor. This option is very useful for situations in which you want to configure parameters for a neighbor but are not ready to use the neighbor. You can shut the neighbor down as soon as you have added it the routing switch, configure the neighbor parameters, then allow the routing switch to reestablish a session with the neighbor by removing the shutdown option from the neighbor.

When you apply the new option to shut down a neighbor, the option takes place immediately and remains in effect until you remove the option. If you save the configuration to the startup-config file, the shutdown option remains in effect even after a software reload.

NOTE: The software also contains an option to end the session with a BGP4 neighbor and thus clear the routes learned from the neighbor. Unlike this clear option, the option for shutting down the neighbor can be saved in the startup-config file and thus can prevent the routing switch from establishing a BGP4 session with the neighbor even after reloading the software.

NOTE: If you notice that a particular BGP4 neighbor never establishes a session with the HP routing switch, check the routing switch’s running-config and startup-config files to see whether the configuration contains a command that is shutting down the neighbor. The neighbor may have been shut down previously by an administrator.

To shut down a BGP4 neighbor, use either of the following methods.

USING THE CLI

To shut down a BGP4 neighbor, enter commands such as the following:

```
HP9300(config)# router bgp
HP9300(config-bgp-router)# neighbor 209.157.22.26 shutdown
HP9300(config-bgp-router)# write memory
```

Syntax: [no] neighbor <ip-addr> shutdown

The <ip-addr> parameter specifies the IP address of the neighbor.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Neighbor link to display the BGP Neighbor panel.

NOTE: If the device already has neighbors, a table listing the neighbors is displayed. Click the Modify button to the right of the row describing the neighbor to change its configuration, or click the Add Neighbor link to display the BGP Neighbor configuration panel.

5. Enter or modify parameters as needed. For detailed information, see "Adding BGP4 Neighbors" on page 10-14.
6. Select the Enable radio button next to Shutdown.
7. Click the Add button (if you are adding a new neighbor) or the Modify button (if you are modifying a neighbor that is already configured) to apply the changes to the device's running-config file.
8. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Optional Configuration Tasks

The following sections describe how to perform optional BGP4 configuration tasks.

Changing the Keep Alive Time and Hold Time

The Keep Alive Time specifies how frequently the routing switch will send KEEPALIVE messages to its BGP4 neighbors. The Hold Time specifies how long the routing switch will wait for a KEEPALIVE or UPDATE message from a neighbor before concluding that the neighbor is dead. When the routing switch concludes that a BGP4 neighbor is dead, the routing switch ends the BGP4 session and closes the TCP connection to the neighbor.

The default Keep Alive time is 60 seconds. The default Hold Time is 180 seconds. To change the timers, use either of the following methods.

NOTE: Generally, you should set the Hold Time to three times the value of the Keep Alive Time.

NOTE: You can override the global Keep Alive Time and Hold Time on individual neighbors. See "Adding BGP4 Neighbors" on page 10-14.

USING THE CLI

To change the Keep Alive Time to 30 and Hold Time to 90, enter the following command:

```
HP9300(config-bgp-router)# timers keep-alive 30 hold-time 90
```

Syntax: timers keep-alive <num> hold-time <num>

For each keyword, <num> indicates the number of seconds. The Keep Alive Time can be 0 – 65535. The Hold Time can be 0 or 3 – 65535 (1 and 2 are not allowed). If you set the Hold Time to 0, the routing switch waits indefinitely for messages from a neighbor without concluding that the neighbor is dead.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.

3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.
5. Edit the number in the Keep Alive Time field. The Keep Alive Time can be 0 – 65535.
6. Edit the number in the Hold Time field. The Hold Time can be 0 or 3 – 65535 (1 and 2 are not allowed). If you set the Hold Time to 0, the routing switch waits indefinitely for messages from a neighbor without concluding that the neighbor is dead.

NOTE: Generally, you should set the Hold Time to three times the value of the Keep Alive Time.

7. Click the Apply button to apply the changes to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Enabling Fast External Fallover

BGP4 routers rely on KEEPALIVE and UPDATE messages from neighbors to signify that the neighbors are alive. For BGP4 neighbors that are two or more hops away, such messages are the only indication that the BGP4 protocol has concerning the alive state of the neighbors. As a result, if a neighbor dies, the routing switch will wait until the Hold Time expires before concluding that the neighbor is dead and closing its BGP4 session and TCP connection with the neighbor.

The routing switch waits for the Hold Time to expire before ending the connection to a directly-attached BGP4 neighbor that dies.

For directly attached neighbors, the routing switch to immediately senses loss of a connection to the neighbor from a change to the state of the port or interface that connects the routing switch to its neighbor. For directly attached EBGP neighbors, the routing switch can use this information to immediately close the BGP4 session and TCP connection to locally attached neighbors that die.

NOTE: The fast external fallover feature applies only to directly attached EBGP neighbors. The feature does not apply to IBGP neighbors.

If you want to enable the routing switch to immediately close the BGP4 session and TCP connection to locally attached neighbors that die, use either of the following methods.

USING THE CLI

To enable fast external fallover, enter the following command:

```
HP9300(config-bgp-router)# fast-external-fallover
```

To disable fast external fallover again, enter the following command:

```
HP9300(config-bgp-router)# no fast-external-fallover
```

Syntax: [no] fast-external-fallover

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.
5. Select Disable or Enable next to Fast External Fall Over.
6. Click the Apply button to apply the changes to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Changing the Maximum Number of Paths for BGP4 Load Sharing

Load sharing enables the routing switch to balance traffic to a route across multiple equal-cost paths of the same type (EBGP or IBGP) for the route.

To configure the routing switch to perform BGP4 load sharing:

- Enable IP load sharing if it is disabled.
- Set the maximum number of paths. The default maximum number of BGP4 load sharing paths is 1, which means no BGP4 load sharing takes place by default.

NOTE: The maximum number of BGP4 load sharing paths cannot be greater than the maximum number of IP load sharing paths.

How Load Sharing Affects Route Selection

During evaluation of multiple paths to select the best path to a given destination for installment in the IP route table, the last comparison the routing switch performs is a comparison of the internal paths.

- When IP load sharing is disabled, the routing switch prefers the path to the router with the lower router ID.
- When IP load sharing and BGP4 load sharing are enabled, the routing switch balances the traffic across the multiple paths instead of choosing just one path based on router ID.

See “How BGP4 Selects a Path for a Route” on page 10-3 for a description of the BGP4 algorithm.

When you enable IP load sharing, the routing switch can load balance BGP4 or OSPF routes across up to four equal paths by default. You can change the number of IP load sharing paths to a value from 2 – 8.

How Load Sharing Works

Load sharing is performed in round-robin fashion and is based on the destination IP address only. The first time the routing switch receives a packet destined for a specific IP address, the routing switch uses a round-robin algorithm to select the path that was not used for the last newly learned destination IP address. Once the routing switch associates a path with a particular destination IP address, the routing switch will always use that path as long as the routing switch contains the destination IP address in its cache.

NOTE: The routing switch does not perform source routing. The routing switch is concerned only with the paths to the next-hop routers, not the entire paths to the destination hosts.

A BGP4 destination can be learned from multiple BGP4 neighbors, leading to multiple BGP4 paths to reach the same destination. Each of the paths may be reachable through multiple IGP paths (multiple OSPF or RIP paths). In this case, the software installs all the multiple equal-cost paths in the BGP4 route table, up to the maximum number of BGP4 equal-cost paths allowed.

If the administrative distance of the paths is lower than the administrative distance of paths from other sources (such as static IP routes, RIP, or OSPF), the BGP4 paths also are installed in the IP route table. The IP load sharing feature then distributes traffic across the equal-cost paths to the destination.

If an IGP path underlying a BGP4 path installed in the IP route table changes, then the BGP4 paths and IP paths are adjusted accordingly. For example, if one of the OSPF paths to reach the BGP4 next hop goes down, the software removes this path from the BGP4 route table and the IP route table. Similarly, if an additional OSPF path becomes available to reach the BGP4 next-hop router for a particular destination, the software adds the additional path to the BGP4 route table and the IP route table.

Changing the Maximum Number of Shared BGP4 Paths

When IP load sharing is enabled, BGP4 can balance traffic to a specific destination across up to four equal paths. You can set the maximum number of paths to a value from 1 – 4. The default is 1.

NOTE: The maximum number of BGP4 load sharing paths cannot be greater than the maximum number of IP load sharing paths. To increase the maximum number of IP load sharing paths, use the **ip load sharing** <num> command at the global CONFIG level of the CLI or use the # of Paths field next to Load Sharing on the IP configuration panel of the Web management interface.

USING THE CLI

To change the maximum number of shared paths, enter commands such as the following:

```
HP9300(config)# router bgp
HP9300(config-bgp-router)# maximum-paths 4
HP9300(config-bgp-router)# write memory
```

Syntax: [no] maximum-paths <num>

The <num> parameter specifies the maximum number of paths across which the routing switch can balance traffic to a given BGP4 destination. You can change the maximum number of paths to a value from 2 – 4. The default is 1.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.
5. Edit the number in the # of Paths field if needed. You can specify from 1 – 4 paths. The default is 1. You cannot set the maximum number of BGP4 paths to a number higher than the IP load sharing maximum number of paths.
6. Click the Apply button to apply the changes to the device's running-config file.
7. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Specifying a List of Networks to Advertise

By default, the routing switch sends BGP4 routes only for the networks you identify using the **network** command or that are redistributed into BGP4 from RIP or OSPF. You can specify up to 600 networks.

To specify a network to be advertised, use either of the following methods.

NOTE: The exact route must exist in the IP route table before the routing switch can create a local BGP route.

USING THE CLI

To configure the routing switch to advertise network 209.157.22.0/24, enter the following command:

```
HP9300(config-bgp-router)# network 209.157.22.0 255.255.255.0
```

Syntax: network <ip-addr> <ip-mask> [route-map <map-name>] | [weight <num>] | [backdoor]

The <ip-addr> is the network number and the <ip-mask> specifies the network mask.

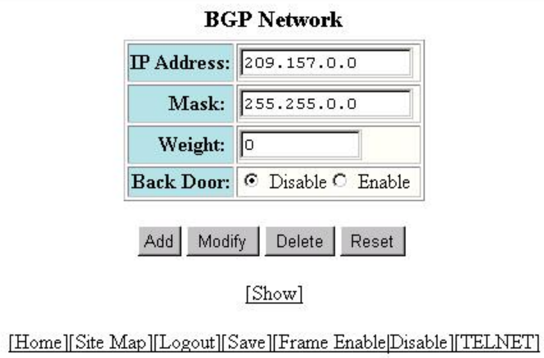
The **route-map** <map-name> parameter specifies the name of the route map you want to use to set or change BGP4 attributes for the network you are advertising. The route map must already be configured.

The **weight** <num> parameter specifies a weight to be added to routes to this network.

The **backdoor** parameter changes the administrative distance of the route to this network from the EBGP administrative distance (20 by default) to the Local BGP weight (200 by default), thus tagging the route as a backdoor route. Use this parameter when you want the routing switch to prefer IGP routes such as RIP or OSPF routes over the EBGP route for the network.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Network link.
   - If the device does not have any BGP networks configured, the BGP Network configuration panel is displayed, as shown in the following example.
   - If a BGP network is already configured and you are adding a new one, click on the Add Network link to display the BGP Network configuration panel, as shown in the following example.
   - If you are modifying an existing BGP network, click on the Modify button to the right of the row describing the network to display the BGP Network configuration panel, as shown in the following example.



5. Enter the network address in the IP Address field.
6. Enter the network mask in the Mask field.
7. Optionally enter a weight to be added to routes to this network.
8. If you want to tag the route as a backdoor route, select Enable next to Back Door.
9. Click the Apply button to apply the changes to the device's running-config file.
10. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Specifying a Route Map Name when Configuring BGP4 Network Information

You can specify a route map as one of the parameters when you configure a BGP4 network to be advertised. The routing switch can use the route map to set or change BGP4 attributes when creating a local BGP4 route.

To configure network information and use a route map to set or change BGP4 attributes, use the following CLI method.

NOTE: You must configure the route map before you can specify the route map name in a BGP4 network configuration.

USING THE CLI

To configure a route map, and use it to set or change route attributes for a network you define for BGP4 to advertise, enter commands such as the following:

```
HP9300(config)# route-map set_net permit 1
HP9300(config-routemap set_net)# set community no-export
HP9300(config-routemap set_net)# exit
```

```
HP9300(config)# router bgp
HP9300(config-bgp-router)# network 100.100.1.0/24 route-map set_net
```

The first two commands in this example create a route map named “set_net” that sets the community attribute for routes that use the route map to “NO_EXPORT”. The next two commands change the CLI to the BGP4 configuration level. The last command configures a network for advertising from BGP4, and associates the “set_net” route map with the network. When BGP4 originates the 100.100.1.0/24 network, BGP4 also sets the community attribute for the network to “NO_EXPORT”.

Syntax: network <ip-addr> <ip-mask> [route-map <map-name>] | [weight <num>] | [backdoor]

The **route-map** <map-name> parameter specifies the name of the route map you want to use to set or change BGP4 attributes for the network you are advertising. The route map must already be configured.

For information about the other parameters, see “Defining Route Maps” on page 10-59.

USING THE WEB MANAGEMENT INTERFACE

You cannot add a route map to a BGP4 network definition using the Web management interface.

Changing the Default Local Preference

When the routing switch uses the BGP4 algorithm to select a route to send to the IP route table, one of the parameters the algorithm uses is the local preference. Local preference is an attribute that indicates a degree of preference for a route relative to other routes. BGP4 neighbors can send the local preference value as an attribute of a route in an UPDATE message.

Local preference applies only to routes within the local AS. BGP4 routers can exchange local preference information with neighbors who also are in the local AS, but BGP4 routers do not exchange local preference information with neighbors in remote ASs.

The default local preference is 100. For routes learned from EBGP neighbors, the default local preference is assigned to learned routes. For routes learned from IBGP neighbors, the local preference value is not changed for the route.

When the BGP4 algorithm compares routes on the basis of local preferences, the route with the higher local preference is chosen.

NOTE: To set the local preference for individual routes, use route maps. See “Defining Route Maps” on page 10-59. See “How BGP4 Selects a Path for a Route” on page 10-3 for information about the BGP4 algorithm.

To change the default local preference used by the routing switch, use either of the following methods.

USING THE CLI

To change the default local preference to 200, enter the following command:

```
HP9300(config-bgp-router)# default-local-preference 200
```

Syntax: default-local-preference <num>

The <num> parameter indicates the preference and can be a value from 0 – 4294967295.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.
5. Change the number in the Default Local Preference field. You can enter a number from 0 – 4294967295.
6. Click the Apply button to apply the changes to the device’s running-config file.

7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Advertising the Default Information Originate

By default, the routing switch does not originate and advertise a default route using BGP4. A BGP4 default route is the IP address 0.0.0.0 and the route prefix 0 or network mask 0.0.0.0. For example, 0.0.0.0/0 is a default route. You can enable the routing switch to advertise a default BGP4 route using either of the following methods.

NOTE: The HP routing switch checks for the existence of an IGP route for 0.0.0.0/0 in the IP route table before creating a local BGP route for 0.0.0.0/0.

USING THE CLI

To enable the routing switch to originate and advertise a default BGP4 route, enter the following command:

```
HP9300(config-bgp-router)# default-information-originate
```

Syntax: [no] default-information-originate

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.
5. Select Disable or Enable next to Default Information Originate.
6. Click the Apply button to apply the changes to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Changing the Default MED (Metric) Used for Route Redistribution

The HP routing switch can redistribute RIP and OSPF routes into BGP4. The MED (metric) is a global parameter that specifies the cost that will be applied to all routes by default when they are redistributed into BGP4. When routes are selected, lower metric values are preferred over higher metric values. The default BGP4 MED value is 0 and can be assigned a value from 0 – 4294967295.

NOTE: RIP and OSPF also have default metric parameters. The parameters are set independently for each protocol and have different ranges.

USING THE CLI

To change the default metric to 40, enter the following command:

```
HP9300(config-bgp-router)# default-metric 40
```

Syntax: default-metric <num>

The <num> indicates the metric and can be a value from 0 – 4294967295.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.

5. Change the number in the Default Metric field. You can enter a number from 0 – 4294967295.
6. Click the Apply button to apply the changes to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Changing Administrative Distances

BGP4 routers can learn about networks from various protocols, including the EBGP portion of BGP4 and IGPs such as OSPF and RIP. Consequently, the routes to a network may differ depending on the protocol from which the routes were learned.

To select one route over another based on the source of the route information, the routing switch can use the administrative distances assigned to the sources. The administrative distance is a protocol-independent metric that IP routers use to compare routes from different sources.

The routing switch re-advertises a learned best BGP4 route to the routing switch's neighbors even when the software does not also select that route for installation in the IP route table. The best BGP4 routes is the BGP4 path that the software selects based on comparison of the paths' BGP4 route parameters. See "How BGP4 Selects a Path for a Route" on page 10-3.

When selecting a route from among different sources (BGP4, OSPF, RIP, static routes, and so on), the software compares the routes on the basis of each route's administrative distance. The routing switch re-advertises a learned best BGP4 route to neighbors by default, regardless of whether the route's administrative distance is lower than other routes from different route sources to the same destination.

NOTE: In software release 05.0.00 and later, the software will replace a statically configured default route with a learned default route if the learned route's administrative distance is lower than the statically configured default route's distance. However, the default administrative distance for static routes is changed to 1 in software release 05.2.00, so only directly-connected routes are preferred over static routes when the default administrative distances for the routes are used.

Here are the default administrative distances on the HP routing switch:

- Directly connected – 0 (this value is not configurable)
- Static – 1 (applies to all static routes, including default routes)
- EBGP – 20
- OSPF – 110
- RIP – 120
- IBGP – 200
- Local BGP – 200
- Unknown – 255 (the routing switch will not use this route)

Lower administrative distances are preferred over higher distances. For example, if the routing switch receives routes for the same network from OSPF and from RIP, the routing switch will prefer the OSPF route by default. The administrative distances are configured in different places in the software.

- To change the EBGP, IBGP, and Local BGP default administrative distances, see the instructions in this section.
- To change the default administrative distance for OSPF, see "Modify Administrative Distance" on page 8-34.
- To change the default administrative distance for RIP, see "Changing the Administrative Distance" on page 7-6.
- To change the default administrative distance for static routes, see "Configuring Static Routes" on page 6-36.

You can change the default EBGP, IBGP, and Local BGP administrative distances using either of the following methods.

USING THE CLI

To change the default administrative distances for EBGP, IBGP, and Local BGP, enter a command such as the following:

```
HP9300(config-bgp-router)# distance 180 160 40
```

Syntax: distance <external-distance> <internal-distance> <local-distance>

The <external-distance> sets the EBGP distance and can be a value from 1 – 255.

The <internal-distance> sets the IBGP distance and can be a value from 1 – 255.

The <local-distance> sets the Local BGP distance and can be a value from 1 – 255.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.
5. Change the number in the External Distance field to change the EBGP distance. You can enter a number from 1 – 255.
6. Change the number in the Internal Distance field to change the IBGP distance. You can enter a number from 1 – 255.
7. Change the number in the Local Distance field to change the local distance. You can enter a number from 1 – 255.
8. Click the Apply button to apply the changes to the device's running-config file.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring the routing switch To Always Compare Multi-Exit Discriminators (MEDs)

A Multi-Exit Discriminator (MED) is a value that the BGP4 algorithm uses when comparing multiple paths received from different BGP4 neighbors in the same AS for the same route. In BGP4, a route's MED is equivalent to its "metric".

By default, the routing switch compares the MED values only among paths through the same AS. For example, if the routing switch receives BGP4 updates from a remote AS with multiple paths for the same route, the routing switch compares the MEDs in those paths to select a preferred path for the route.

You can change the routing switch's default behavior and configure the routing switch to instead compare the MEDs for all paths for a route, regardless of the AS through which the paths pass. For example, if the routing switch receives UPDATES for the same route from neighbors in three ASs, the routing switch would compare the MEDs of all the paths together, rather than comparing the MEDs for the paths in each AS individually.

To configure the routing switch to always compare MEDs for all paths for a route, use either of the following methods:

USING THE CLI

To configure the routing switch to always compare MEDs, enter the following command:

```
HP9300(config-bgp-router)# always-compare-med
```

Syntax: [no] always-compare-med

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.
5. Select Disable or Enable next to Always Compare MED.
6. Click the Apply button to apply the changes to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Synchronizing Routes

By default, the routing switch does not wait until the IGPs in the local AS have fully exchanged route information before BGP4 advertises the routes to its remote BGP4 neighbors. The routing switch advertises routes to its remote BGP4 neighbors regardless of whether the routes are learned or have already been propagated throughout the local AS.

If you want the routing switch to wait until the IGPs in the local AS have fully exchanged route information before BGP4 advertises the routes to its remote BGP4 neighbors, enable synchronization.

To enable synchronization, use either of the following methods.

USING THE CLI

To enable synchronization, enter the following command:

```
HP9300(config-bgp-router)# synchronization
```

To disable synchronization again, enter the following command:

```
HP9300(config-bgp-router)# no synchronization
```

Syntax: [no] synchronization

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.
5. Select Disable or Enable next to Synchronization.
6. Click the Apply button to apply the changes to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Automatically Summarizing Subnet Routes Into Class A, B, or C Networks

The auto summary feature summarizes the routes it redistributes from IGP to BGP4. The routing switch summarizes subnets into their natural class A, B, or C networks. For example, if an AS contains subnets 1.1.0.0, 1.2.0.0, and 1.3.0.0 with the network mask 255.255.0.0, the auto summary feature summarizes the subnets in its advertisements to BGP4 neighbors as 1.0.0.0/8.

The auto summary feature is disabled by default. If you want to enable the feature, use either of the following methods.

NOTE: The auto summary feature summarizes only the routes that are redistributed from IGP into BGP4.

NOTE: The auto summary feature does not summarize networks that use CIDR numbers instead of class A, B, or C numbers. To summarize CIDR networks, use the aggregation feature. See "Aggregating Routes Advertised to BGP4 Neighbors" on page 10-39.

USING THE CLI

To enable auto summary, enter the following command:

```
HP9300(config-bgp-router)# auto-summary
```

To disable auto summary again, enter the following command:

```
HP9300(config-bgp-router)# no auto-summary
```

Syntax: [no] auto-summary

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.
5. Select Disable or Enable next to Auto Summary.
6. Click the Apply button to apply the changes to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring Route Reflection Parameters

Normally, all the BGP routers within an AS are fully meshed. Each of the routers has an IBGP session with each of the other BGP routers in the AS. Each IBGP router thus has a route for each of its IBGP neighbors. For large ASs containing many IBGP routers, the IBGP route information in each of the fully-meshed IBGP routers can introduce too much administrative overhead.

To avoid this problem, you can hierarchically organize your IGP routers into clusters.

- A ***cluster*** is a group of IGP routers organized into route reflectors and route reflector clients. You configure the cluster by assigning a cluster ID on the route reflector and identifying the IGP neighbors that are members of that cluster. All the configuration for route reflection takes place on the route reflectors. The clients are unaware that they are members of a route reflection cluster. All members of the cluster must be in the same AS. The cluster ID can be any number from 1 – 4294967295. The default is the router ID, expressed as a 32-bit number.

  NOTE: If the cluster contains more than one route reflector, you need to configure the same cluster ID on all the route reflectors in the cluster. The cluster ID helps route reflectors avoid loops within the cluster.

- A ***route reflector*** is an IGP router configured to send BGP route information to all the clients (other BGP4 routers) within the cluster. Route reflection is enabled on all HP BGP4 routing switches by default but does not take effect unless you add route reflector clients to the routing switch.
- A ***route reflector client*** is an IGP router identified as a member of a cluster. You identify a routing switch as a route reflector client on the routing switch that is the route reflector, not on the client. The client itself requires no additional configuration. In fact, the client does not know that it is a route reflector client. The client just knows that it receives updates from its neighbors and does not know whether one or more of those neighbors are route reflectors.

NOTE: Route reflection applies only among IBGP routers within the same AS. You cannot configure a cluster that spans multiple ASs.

Figure 10.3 shows an example of a route reflector configuration. In this example, two routing switches are configured as route reflectors for the same cluster. The route reflectors provide redundancy in case one of the reflectors becomes unavailable. Without redundancy, if a route reflector becomes unavailable, its clients are cut off from BGP4 updates.

AS1 contains a cluster with two route reflectors and two clients. The route reflectors are fully meshed with other BGP4 routers, but the clients are not fully meshed. They rely on the route reflectors to propagate BGP4 route updates.

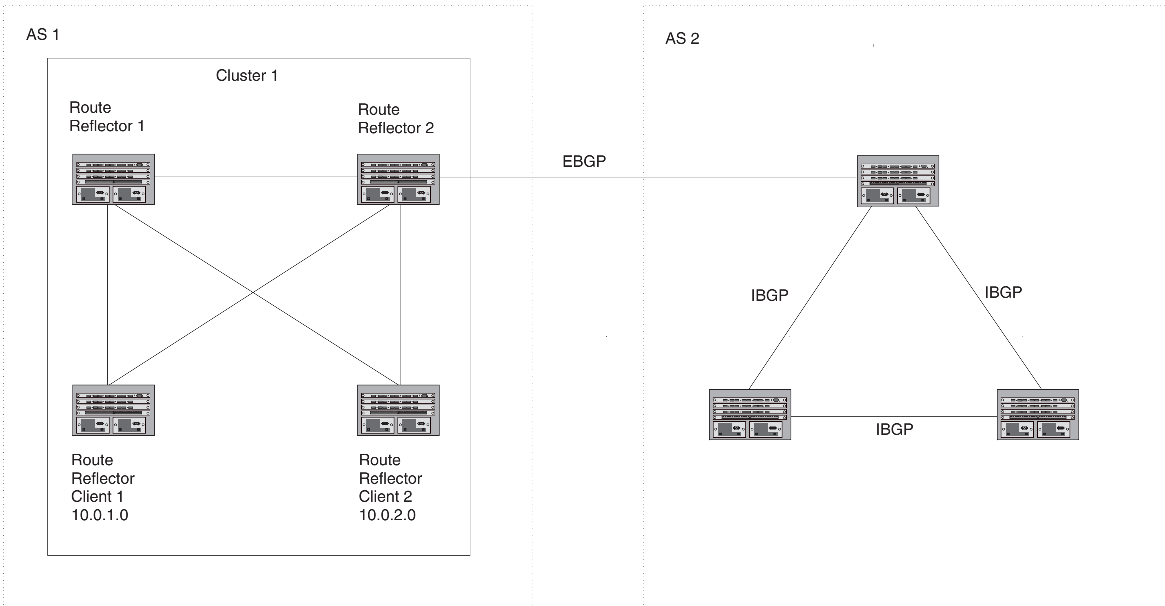


Figure 10.3 Example route reflector configuration

Support for RFC 2796

In software release 07.1.10 and higher, route reflection is based on RFC 2796. This updated RFC helps eliminate routing loops that are possible in some implementations of the older specification, RFC 1966.

NOTE: The configuration procedure for route reflection is the same regardless of whether your software release is using RFC 1966 or RFC 2796. However, the operation of the feature is different as explained below.

RFC 2796 provides more details than RFC 1966 regarding the use of the route reflection attributes, ORIGINATOR_ID and CLUSTER_LIST, to help prevent loops.

- ORIGINATOR_ID – Specifies the router ID of the BGP4 router that originated the route. The route reflector inserts this attribute when reflecting a route to an IBGP neighbor. If a BGP4 router receives an advertisement that contains its own router ID as the ORIGINATOR_ID, the router discards the advertisement and does not forward it.
- CLUSTER_LIST – A list of the route reflection clusters through which the advertisement has passed. A cluster contains a route reflector and its clients. When a route reflector reflects a route, the route reflector adds its cluster ID to the front of the CLUSTER_LIST. If a route reflector receives a route that has its own cluster ID, the router discards the advertisement and does not forward it.

Software release 07.1.10 and higher handles the attributes as follows:

- The routing switch adds the attributes only if it is a route reflector, and only when advertising IBGP route information to other IBGP neighbors. The attributes are not used when communicating with EBGP neighbors.
- A routing switch configured as a route reflector sets the ORIGINATOR_ID attribute to the router ID of the router that originated the route. Moreover, the route reflector sets the attribute only if this is the first time the route is being reflected (sent by a route reflector). In previous software releases, the route reflector set the attribute to the router ID of the route reflector itself. When a routing switch receives a route that already has the ORIGINATOR_ID attribute set, the routing switch does not change the value of the attribute.
- If a routing switch receives a route whose ORIGINATOR_ID attribute has the value of the routing switch's own router ID, the routing switch discards the route and does not advertise it. By discarding the route, the routing switch prevents a routing loop. The routing switch did not discard the route in previous software releases.
- The first time a route is reflected by a routing switch configured as a route reflector, the route reflector adds the CLUSTER_LIST attribute to the route. Other route reflectors who receive the route from an IBGP neighbor add their cluster IDs to the front of the route's CLUSTER_LIST. If the route reflector does not have a cluster ID configured, the routing switch adds its router ID to the front of the CLUSTER_LIST.
- If routing switch configured as a route reflector receives a route whose CLUSTER_LIST contains the route reflector's own cluster ID, the route reflector discards the route and does not forward it.

Configuration Procedures

To configure an HP routing switch to be a BGP4 route reflector, use either of the following methods.

NOTE: All configuration for route reflection takes place on the route reflectors, not on the clients.

USING THE CLI

Enter the following commands to configure an HP routing switch as route reflector 1 in Figure 10.3 on page 10-34. To configure route reflector 2, enter the same commands on the HP routing switch that will be route reflector 2. The clients require no configuration for route reflection.

```
HP9300(config-bgp-router)# cluster-id 1
HP9300(config-bgp-router)# neighbor 10.0.1.0 route-reflector-client
HP9300(config-bgp-router)# neighbor 10.0.2.0 route-reflector-client
```

Syntax: cluster-id <num>

The <num> parameter specifies the cluster ID and can be a number from 1 – 4294967295. The default is the router ID, expressed as a 32-bit number. You can configure one cluster ID on the routing switch. All route-reflector clients for the routing switch are members of the cluster.

NOTE: If the cluster contains more than one route reflector, you need to configure the same cluster ID on all the route reflectors in the cluster. The cluster ID helps route reflectors avoid loops within the cluster.

To add an IBGP neighbor to the cluster, enter the following command:

Syntax: neighbor <ip-addr> route-reflector-client

For more information abut the **neighbor** command, see "Adding BGP4 Neighbors" on page 10-14.

If you need to disable route reflection between clients, enter the following command. When the feature is disabled, route reflection does not occur between clients but reflection does still occur between clients and non-clients.

```
HP9300(config-bgp-router)# no client-to-client-reflection
```

Enter the following command to re-enable the feature:

```
HP9300(config-bgp-router)# client-to-client-reflection
```

Syntax: [no] client-to-client-reflection

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.
5. If route reflection is not already enabled, select Enable next to Client To Client Reflection.
6. If the autonomous system (AS) the routing switch is in will contain more than one route reflector (a route reflector in addition to the routing switch), enter a cluster ID in the Cluster ID field. The cluster ID is required to avoid loops in an AS that contains more than one route reflector.
7. Click the Apply button to apply the changes to the device's running-config file.
8. Click on the Neighbor link at the bottom of the BGP configuration panel or under BGP in the Configure section of the tree view.
9. If you have already configured neighbors, a table listing the neighbors is displayed. Click Modify next to the neighbor you want to identify as a route reflector client or select the Add Neighbor link. The BGP configuration panel is displayed.
10. Configure or change other parameters if needed, then identify this neighbor as a route reflector client by selecting Enable next to Client To Client Reflection. See "Adding BGP4 Neighbors" on page 10-14 for information about the other neighbor parameters.
11. Click the Add button to apply the changes to the device's running-config file.
12. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring Confederations

A ***confederation*** is a BGP4 Autonomous System (AS) that has been subdivided into multiple, smaller ASs. Subdividing an AS into smaller ASs simplifies administration and reduces BGP-related traffic, thus reducing the complexity of the Interior Border Gateway Protocol (IBGP) mesh among the BGP routers in the AS.

The HP implementation of this feature is based on RFC 1965.

Normally, all BGP routers within an AS must be fully meshed, so that each BGP router has interfaces to all the other BGP routers within the AS. This is feasible in smaller ASs but becomes unmanageable in ASs containing many BGP routers.

When you configure BGP routers into a confederation, all the routers within a sub-AS (a subdivision of the AS) use IBGP and must be fully meshed. However, routers use EBGP to communicate between different sub-ASs.

NOTE: Another method for reducing the complexity of an IBGP mesh is to use route reflection. However, if you want to run different Interior Gateway Protocols (IGPs) within an AS, configure a confederation. You can run a separate IGP within each sub-AS.

To configure a confederation, configure groups of BGP routers into sub-ASs. A sub-AS is simply an AS. The term "sub-AS" distinguishes ASs within a confederation from ASs that are not in a confederation. For the viewpoint of remote ASs, the confederation ID is the AS ID. Remote ASs do not know that the AS represents multiple sub-ASs with unique AS IDs.

NOTE: You can use any valid AS numbers for the sub-ASs. If your AS is connected to the Internet, HP recommends that you use numbers from within the private AS range (64512 – 65535). These are private ASs numbers and BGP4 routers do not propagate these AS numbers to the Internet.

Figure 10.4 shows an example of a BGP4 confederation.

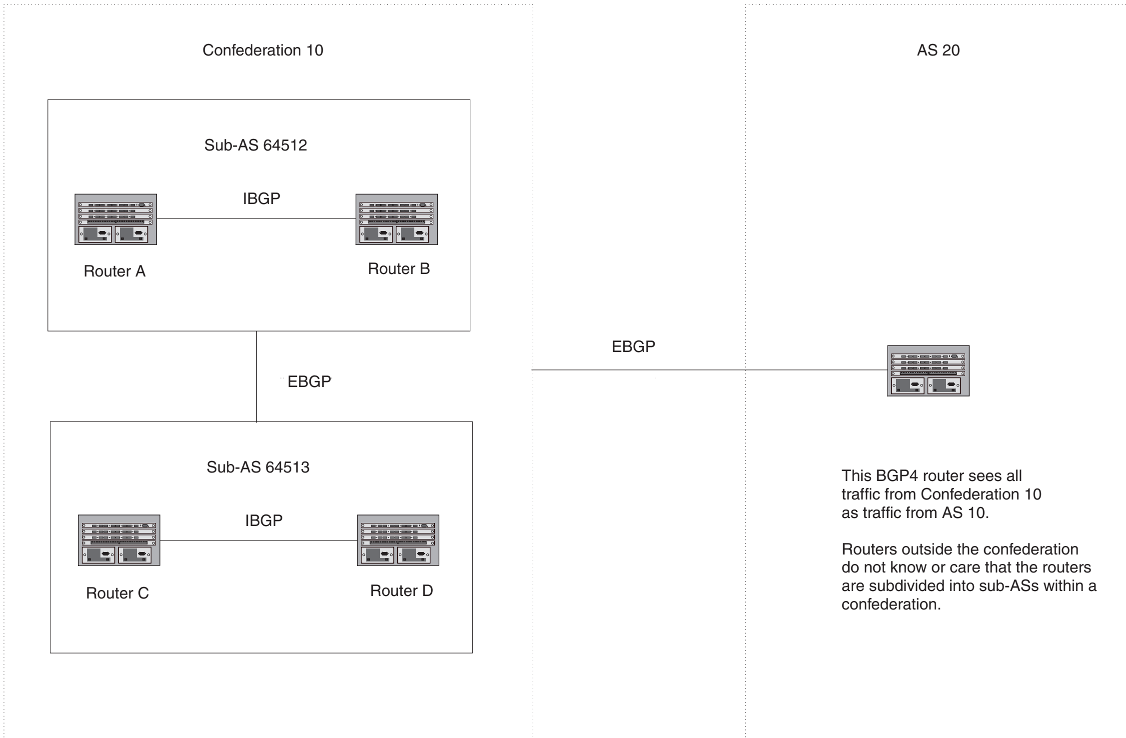


Figure 10.4 Example BGP4 confederation

In this example, four routing switches are configured into two sub-ASs, each containing two of the routing switches. The sub-ASs are members of confederation 10. Routers within a sub-AS must be fully meshed and communicate using IBGP. In this example, routers A and B use IBGP to communicate. Routers C and D also use IBGP. However, the sub-ASs communicate with one another using EBGP. For example, router A communicates with router C using EBGP. The routers in the confederation communicate with other ASs using EBGP.

Routers in other ASs are unaware that routers A – D are configured in a confederation. In fact, when routers in confederation 10 send traffic to routers in other ASs, the confederation ID is the same as the AS number for the routers in the confederation. Thus, routers in other ASs see traffic from AS 10 and are unaware that the routers in AS 10 are subdivided into sub-ASs within a confederation.

Configuring a BGP Confederation

Perform the following configuration tasks on each BGP router within the confederation:

- Configure the local AS number. The local AS number indicates membership in a sub-AS. All BGP routers with the same local AS number are members of the same sub-AS. BGP routers use the local AS number when communicating with other BGP routers within the confederation.
- Configure the confederation ID. The confederation ID is the AS number by which BGP routers outside the confederation know the confederation. Thus, a BGP router outside the confederation is not aware and does not care that your BGP routers are in multiple sub-ASs. BGP routers use the confederation ID when communicating with routers outside the confederation. The confederation ID must be different from the sub-AS numbers.
- Configure the list of the sub-AS numbers that are members of the confederation. All the routers within the same sub-AS use IBGP to exchange router information. Routers in different sub-ASs within the confederation use EBGP to exchange router information.

To configure a routing switch to be a member of a BGP confederation, use one of the following methods. The procedures show how to implement the example confederation shown in Figure 10.4.

USING THE CLI

To configure four routing switches to be a member of confederation 10, consisting of two sub-ASs (64512 and 64513), enter commands such as the following.

Commands for Router A

```
HP9300A(config)# router bgp
HP9300A(config-bgp-router)# local-as 64512
HP9300A(config-bgp-router)# confederation identifier 10
HP9300A(config-bgp-router)# confederation peers 64512 64513
HP9300A(config-bgp-router)# write memory
```

Syntax: local-as <num>

The <num> parameter with the **local-as** command indicates the AS number for the BGP routers within the sub-AS. You can specify a number from 1 – 65535. HP recommends that you use a number within the range of well-known private ASs, 64512 – 65535.

Syntax: confederation identifier <num>

The <num> parameter with the **confederation identifier** command indicates the confederation number. The confederation ID is the AS number by which BGP routers outside the confederation know the confederation. Thus, a BGP router outside the confederation is not aware and does not care that your BGP routers are in multiple sub-ASs. BGP routers use the confederation ID when communicating with routers outside the confederation. The confederation ID must be different from the sub-AS numbers. You can specify a number from 1 – 65535.

Syntax: confederation peers <num> [<num> …]

The <num> parameter with the **confederation peers** command indicates the sub-AS numbers for the sub-ASs in the confederation. You must specify all the sub-ASs contained in the confederation. All the routers within the same sub-AS use IBGP to exchange router information. Routers in different sub-ASs within the confederation use EBGP to exchange router information. You can specify a number from 1 – 65535.

Commands for Router B

```
HP9300B(config)# router bgp
HP9300B(config-bgp-router)# local-as 64512
HP9300B(config-bgp-router)# confederation identifier 10
HP9300B(config-bgp-router)# confederation peers 64512 64513
HP9300B(config-bgp-router)# write memory
```

Commands for Router C

```
HP9300C(config)# router bgp
HP9300C(config-bgp-router)# local-as 64513
HP9300C(config-bgp-router)# confederation identifier 10
HP9300C(config-bgp-router)# confederation peers 64512 64513
HP9300C(config-bgp-router)# write memory
```

Commands for Router D

```
HP9300D(config)# router bgp
HP9300D(config-bgp-router)# local-as 64513
HP9300D(config-bgp-router)# confederation identifier 10
HP9300D(config-bgp-router)# confederation peers 64512 64513
HP9300D(config-bgp-router)# write memory
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.

5. Enter the confederation ID in the Confederation ID field. The confederation ID must be different from the sub-AS numbers. You can specify a number from 1 – 65535.
6. Enter the AS numbers of the peers (sub-ASs) within the confederation in the Confederation Peers field. Separate the AS numbers with spaces. You must specify all the sub-ASs contained in the confederation. All the routers within the same sub-AS use IBGP to exchange router information. Routers in different sub-ASs within the confederation use EBGP to exchange router information. You can specify a number from 1 – 65535.
7. Click the Apply button to apply the changes to the device's running-config file.
8. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Aggregating Routes Advertised to BGP4 Neighbors

By default, the routing switch advertises individual routes for all the networks. The aggregation feature allows you to configure the routing switch to aggregate routes in a range of networks into a single CIDR number. For example, without aggregation, the routing switch will individually advertise routes for networks 207.95.1.0, 207.95.2.0, and 207.95.3.0. You can configure the routing switch to instead send a single, aggregate route for the networks. The aggregate route would be advertised as 207.95.0.0.

NOTE: To summarize CIDR networks, you must use the aggregation feature. The auto summary feature does not summarize networks that use CIDR numbers instead of class A, B, or C numbers.

To aggregate routes, use either of the following methods.

USING THE CLI

To aggregate routes for 209.157.22.0, 209.157.23.0, and 209.157.24.0, enter the following command:

```
HP9300(config-bgp-router)# aggregate-address 209.157.0.0 255.255.0.0
```

Syntax: aggregate-address <ip-addr> <ip-mask> [as-set] [summary-only] [suppress-map <map-name>] [advertise-map <map-name>] [attribute-map <map-name>]

The <ip-addr> and <ip-mask> parameters specify the aggregate value for the networks. Specify 0 for the host portion and for the network portion that differs among the networks in the aggregate. For example, to aggregate 10.0.1.0, 10.0.2.0, and 10.0.3.0, enter the IP address 10.0.0.0 and the network mask 255.255.0.0.

The **as-set** parameter causes the router to aggregate AS-path information for all the routes in the aggregate address into a single AS-path.

The **summary-only** parameter prevents the router from advertising more specific routes contained within the aggregate route.

The **suppress-map** <map-name> parameter prevents the more specific routes contained in the specified route map from being advertised.

The **advertise-map** <map-name> parameter configures the router to advertise the more specific routes in the specified route map.

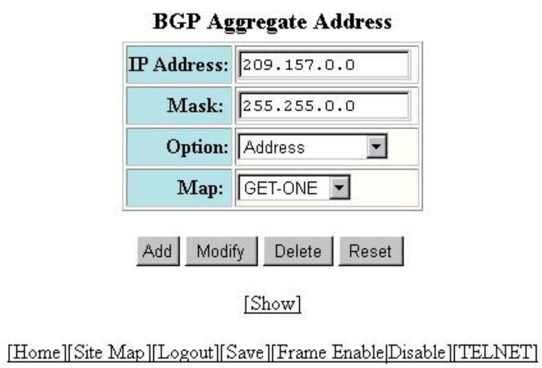
The **attribute-map** <map-name> parameter configures the router to set attributes for the aggregate routes based on the specified route map.

NOTE: For the **suppress-map**, **advertise-map**, and **attribute-map** parameters, the route map must already be defined. See "Defining Route Maps" on page 10-59 for information on defining a route map.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.

3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Aggregate Address link to display the BGP Aggregate Address configuration panel.
   - If the device does not have any BGP aggregate addresses configured, the BGP Aggregate Address configuration panel is displayed, as shown in the following example.
   - If a BGP aggregate address is already configured and you are adding a new one, click on the Add Aggregate Address link to display the BGP Aggregate Address configuration panel, as shown in the following example.
   - If you are modifying an existing BGP aggregate address, click on the Modify button to the right of the row describing the aggregate address to display the BGP Aggregate Address configuration panel, as shown in the following example.



5. Enter the aggregate address in the IP Address field. Specify 0 for the host portion and for the network portion that differs among the networks in the aggregate. For example, to aggregate 10.0.1.0, 10.0.2.0, and 10.0.3.0, enter the IP address 10.0.0.0. Then enter 255.255.0.0 in the Mask field.
6. Enter the mask in the Mask field.
7. Select one of the following options from the Option field's pulldown list:
   - Address – Use this option when you are adding the address. This is the default option.
   - AS Set – This option causes the router to aggregate AS-path information for all the routes in the aggregate address into a single AS-path.
   - Summary Only – This option prevents the router from advertising more specific routes contained within the aggregate route.
   - Suppress Map – This option prevents the more specific routes contained in the specified route map from being advertised.
   - Advertise Map – This option configures the router to advertise the more specific routes in the specified route map.
   - Attribute Map – This option configures the router to set attributes for the aggregate routes based on the specified route map.
8. Optionally select a route map from the Map field's pulldown list.

NOTE: For the Suppress Map, Advertise Map, and Attribute Map options, you must select a route map and the route map must already be defined. See "Defining Route Maps" on page 10-59 for information on defining a route map.

---

9. Click the Add button to apply the changes to the device's running-config file.
10. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Redistribution Parameters

By default, the router does not redistribute route information between BGP4 and the IP IGPs (RIP and OSPF). You can configure the router to redistribute OSPF routes, RIP routes, directly connected routes, or static routes into BGP4. The following subsections describe how to set redistribution parameters.

Redistributing Routes by Route Type

You can easily configure BGP4 to redistribute routes of a specific route type using the following methods.

USING THE CLI

To enable redistribution of all OSPF routes and directly attached routes into BGP4, enter the following commands.

```
HP9300(config)# router bgp
HP9300(config-bgp-router)# redistribution ospf
HP9300(config-bgp-router)# redistribution connected
HP9300(config-bgp-router)# write memory
```

Syntax: [no] redistribution connected | ospf | rip | static

USING THE WEB MANAGEMENT INTERFACE

Use the procedure in "Redistributing RIP Routes".

Redistributing RIP Routes

USING THE CLI

To configure BGP4 to redistribute RIP routes and add a metric of 10 to the redistributed routes, enter the following command:

```
HP9300(config-bgp-router)# redistribute rip metric 10
```

Syntax: redistribute rip [metric <num>] [route-map <map-name>] [weight <num>]

The **rip** parameter indicates that you are redistributing RIP routes into BGP4.

The **metric** <num> parameter changes the metric. You can specify a value from 0 – 4294967295. The default is 0.

The **route-map** <map-name> parameter specifies a route map to be consulted before adding the filter to the IP route table.

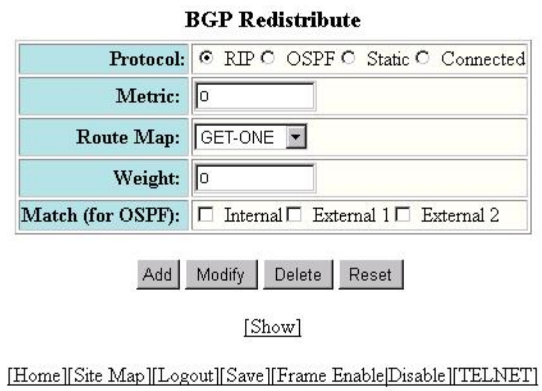
NOTE: The route map you specify must already be configured on the router. See "Defining Route Maps" on page 10-59 for information about defining route maps.

The **weight** <num> parameter changes the weight. You can specify a value from 0 – 65535. The default is 0.

USING THE WEB MANAGEMENT INTERFACE

The following procedure applies to redistributing RIP, OSPF, static, and connected (directly attached) routes.

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Redistribute link to display the BGP Redistribute configuration panel.
   - If the device does not have any BGP redistribution parameters configured, the BGP Redistribute configuration panel is displayed, as shown in the following example.
   - If BGP redistribution parameters are already configured and you are adding new ones, click on the Add Redistribute link to display the BGP Redistribute configuration panel, as shown in the following example.
   - If you are modifying existing BGP redistribution parameters, click on the Modify button to the right of the row describing the redistribution parameters to display the BGP Redistribute configuration panel, as shown in the following example.



5. Select the source of the routes you want to redistribute into BGP4. You can select RIP, OSPF, Static, or Connected (directly attached) routes.

6. Optionally enter a metric for the redistributed routes in the Metric field. You can specify a value from 0 – 4294967295. The default is 0.

7. Optionally select a route map from the Map field's pulldown list.

NOTE: The route map must already be defined. See "Defining Route Maps" on page 10-59 for information on defining a route map.

---

8. Optionally enter a weight for the redistributed routes in the Weight field. You can specify a value from 0 – 65535. The default is 0.

9. For OSPF routes, select one of the following to specify the types of OSPF routes to be redistributed into BGP4:
   - Internal
   - External 1
   - External 2

10. Click the Add button to apply the changes to the device's running-config file.

11. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Redistributing OSPF Routes

To configure the routing switch to redistribute OSPF external type 1 routes, enter the following command:

```
HP9300(config-bgp-router)# redistribute ospf match external1
```

Syntax: redistribute ospf [metric <num>] [route-map <map-name>] [weight <num>]
[match internal | external1 | external2]

The **ospf** parameter indicates that you are redistributing OSPF routes into BGP4.

The **metric** <num> parameter changes the metric. You can specify a value from 0 – 4294967295. The default is 0.

The **route-map** <map-name> parameter specifies a route map to be consulted before adding the filter to the IP route table.

NOTE: The route map you specify must already be configured on the router. See "Defining Route Maps" on page 10-59 for information about defining route maps.

The **weight** <num> parameter changes the weight. You can specify a value from 0 – 65535. The default is 0.

The **match internal | external1 | external2** parameter applies only to OSPF. This parameter specifies the types of OSPF routes to be redistributed into BGP4.

USING THE WEB MANAGEMENT INTERFACE

Use the procedure in "Redistributing RIP Routes" on page 10-41.

Redistributing Static Routes

To configure the routing switch to redistribute static routes, enter the following command:

```
HP9300(config-bgp-router)# redistribute static
```

Syntax: redistribute static [metric <num>] [route-map <map-name>] [weight <num>]

The **static** parameter indicates that you are redistributing static routes into BGP4.

The **metric** <num> parameter changes the metric. You can specify a value from 0 – 4294967295. The default is 0.

The **route-map** <map-name> parameter specifies a route map to be consulted before adding the filter to the IP route table.

NOTE: The route map you specify must already be configured on the router. See "Defining Route Maps" on page 10-59 for information about defining route maps.

The **weight** <num> parameter changes the weight. You can specify a value from 0 – 65535. The default is 0.

USING THE WEB MANAGEMENT INTERFACE

Use the procedure in "Redistributing RIP Routes" on page 10-41.

Disabling or Re-Enabling Re-Advertisement of All Learned BGP4 Routes to All BGP4 Neighbors

By default, the routing switch re-advertises all learned best BGP4 routes to BGP4 neighbors, unless the routes are discarded or blocked by route maps or other filters.

If you want to prevent the routing switch from re-advertising a learned best BGP4 route unless that route also is installed in the IP route table, use the following CLI method.

USING THE CLI

To disable re-advertisement of BGP4 routes to BGP4 neighbors except for routes that the software also installs in the route table, enter the following command:

```
HP9300(config-bgp-router)# no readvertise
```

Syntax: [no] readvertise

To re-enable re-advertisement, enter the following command:

```
HP9300(config-bgp-router)# readvertise
```

USING THE WEB MANAGEMENT INTERFACE

You cannot configure this parameter using the Web management interface.

Redistributing IBGP Routes into RIP and OSPF

By default, the routing switch does not redistribute IBGP routes from BGP4 into RIP or OSPF. This behavior helps eliminate routing loops. However, if your network can benefit from redistributing the IBGP routes from BGP4 into OSPF or RIP, you can enable the routing switch to redistribute the routes. To do so, use the following CLI method.

USING THE CLI

To enable the routing switch to redistribute BGP4 routes from BGP4 into OSPF and RIP, enter the following command:

```
HP9300(config-bgp-router)# bgp-redistribute-internal
```

Syntax: [no] bgp-redistribute-internal

To disable redistribution of IBGP routes into RIP and OSPF, enter the following command:

```
HP9300(config-bgp-router)# no bgp-redistribute-internal
```

USING THE WEB MANAGEMENT INTERFACE

You cannot configure this parameter using the Web management interface.

Filtering Specific IP Addresses

You can configure the router to explicitly permit or deny specific IP addresses received in updates from BGP4 neighbors by defining IP address filters. The router permits all IP addresses by default. You can define up to 100 IP address filters for BGP4.

- If you want permit to remain the default behavior, define individual filters to deny specific IP addresses.
- If you want to change the default behavior to deny, define individual filters to permit specific IP addresses.

NOTE: Once you define a filter, the default action for addresses that do not match a filter is “deny”. To change the default action to “permit”, configure the last filter as “permit any any”.

Address filters can be referred to by a BGP neighbor's distribute list number as well as by match statements in a route map.

NOTE: If the filter is referred to by a route map’s match statement, the filter is applied in the order in which the filter is listed in the match statement.

NOTE: You also can filter on IP addresses by using IP ACLs. See “Using Access Control Lists (ACLs)”.

To define an IP address filter, use either of the following methods.

USING THE CLI

To define an IP address filter to deny routes to 209.157.0.0, enter the following command:

```
HP9300(config-bgp-router)# address-filter 1 deny 209.157.0.0 255.255.0.0
```

Syntax: address-filter <num> permit | deny <ip-addr> <wildcard> <mask> <wildcard>

The <num> parameter is the filter number.

The **permit | deny** parameter indicates the action the routing switch takes if the filter match is true.

- If you specify **permit**, the routing switch permits the route into the BGP4 table if the filter match is true.
- If you specify **deny**, the routing switch denies the route from entering the BGP4 table if the filter match is true.

NOTE: Once you define a filter, the default action for addresses that do not match a filter is “deny”. To change the default action to “permit”, configure the last filter as “permit any any”.

The <ip-addr> parameter specifies the IP address. If you want the filter to match on all addresses, enter **any**.

The <wildcard> parameter specifies the portion of the IP address to match against. The <wildcard> is a four-part value in dotted-decimal notation (IP address format) consisting of ones and zeros. Zeros in the mask mean the packet’s source address must match the <source-ip>. Ones mean any value matches. For example, the <ip-addr> and <wildcard> values 209.157.22.26 0.0.0.255 mean that all hosts in the Class C sub-net 209.157.22.x match the policy.

If you prefer to specify the wildcard (mask value) in Classless Interdomain Routing (CIDR) format, you can enter a forward slash after the IP address, then enter the number of significant bits in the mask. For example, you can enter the CIDR equivalent of “209.157.22.26 0.0.0.255” as “209.157.22.26/24”. The CLI automatically converts the CIDR number into the appropriate mask (where zeros instead of ones are the significant bits) and changes the non-significant portion of the IP address into zeros. For example, if you specify 209.157.22.26/24 or

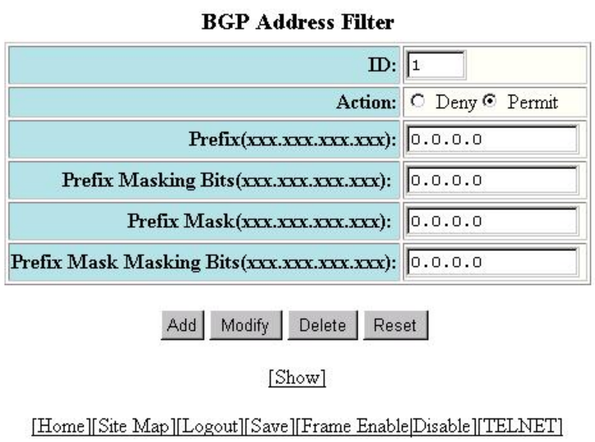
209.157.22.26 0.0.0.255, then save the changes to the startup-config file, the value appears as 209.157.22.0/24 (if you have enabled display of sub-net lengths) or 209.157.22.0 0.0.0.255 in the startup-config file.

If you enable the software to display IP sub-net masks in CIDR format, the mask is saved in the file in “/<mask-bits>” format. To enable the software to display the CIDR masks, enter the **ip show-subnet-length** command at the global CONFIG level of the CLI. You can use the CIDR format to configure the filter regardless of whether the software is configured to display the masks in CIDR format.

The <mask> parameter specifies the network mask. If you want the filter to match on all destination addresses, enter **any**. The wildcard works the same as described above.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the <u>Address Filter</u> link to display the BGP Address Filter panel.
    - If the device does not have any BGP address filters configured, the BGP Address Filter configuration panel is displayed, as shown in the following example.
    - If BGP address filters are already configured and you are adding a new one, click on the <u>Add Address Filter</u> link to display the BGP Address Filter configuration panel, as shown in the following example.
    - If you are modifying an existing BGP address filter, click on the Modify button to the right of the row describing the filter to display the BGP Address Filter configuration panel, as shown in the following example.



5. Enter the filter ID in the ID field. You can specify a number from 1 – 100.
6. Select the action you want the routing switch to perform if the filter is true:
    - If you select Deny, the router denies the route from entering the BGP4 table if the filter match is true.
    - If you select Permit, the router permits the route into the BGP4 table if the filter match is true.
7. Enter the network prefix in the Prefix field. If you specify “any”, all networks match the filter.
8. Enter the prefix masking bits in the Prefix Masking Bits field. The prefix masking bits indicate the bits in the prefix that the filter compares. The filter disregards the bits for which the mask contains zeros.
9. Enter the mask in the Prefix Mask field. If you specify “any”, all masks match the filter.
10. Enter the masking bits for the network mask in the Prefix Mask Masking Bits field.
11. Click the Add button to apply the changes to the device’s running-config file.

12. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Filtering AS-Paths

You can filter updates received from BGP4 neighbors based on the contents of the AS-path list accompanying the updates. For example, if you want to deny routes that have the AS 4.3.2.1 in the AS-path from entering the BGP4 route table, you can define a filter to deny such routes.

The routing switch provides the following methods for filtering on AS-path information:

- AS-path filters
- AS-path ACLs

NOTE: The routing switch cannot actively support AS-path filters and AS-path ACLs at the same time. Use one method or the other but do not mix methods.

NOTE: Once you define a filter or ACL, the default action for updates that do not match a filter is "deny". To change the default action to "permit", configure the last filter or ACL as "permit any any".

AS-path filters or AS-path ACLs can be referred to by a BGP neighbor's distribute list number as well as by match statements in a route map.

Defining an AS-Path Filter

To define an AS-path filter, use either of the following methods.

USING THE CLI

To define AS-path filter 4 to permit AS 2500, enter the following command:

```
HP9300(config-bgp-router)# as-path-filter 4 permit 2500
```

Syntax: as-path-filter <num> permit | deny <as-path>

The <num> parameter identifies the filter's position in the AS-path filter list and can be from 1 – 100. Thus, the AS-path filter list can contain up to 100 filters. The HP routing switch applies the filters in numerical order, beginning with the lowest-numbered filter. When a filter match is true, the routing switch stops and does not continue applying filters from the list.

NOTE: If the filter is referred to by a route map's match statement, the filter is applied in the order in which the filter is listed in the match statement.

The **permit | deny** parameter indicates the action the router takes if the filter match is true.

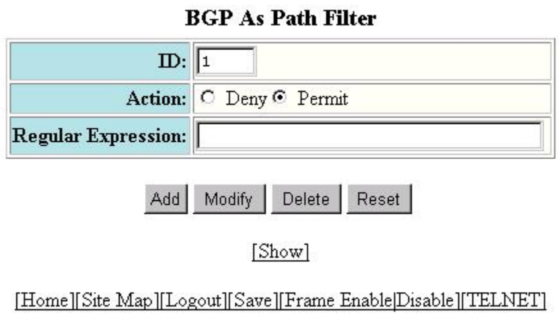
- If you specify **permit**, the router permits the route into the BGP4 table if the filter match is true.
- If you specify **deny**, the router denies the route from entering the BGP4 table if the filter match is true.

The <as-path> parameter indicates the AS-path information. You can enter an exact AS-path string if you want to filter for a specific value. You also can use regular expressions in the filter string.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the AS Path Filter link to display the BGP AS Path Filter panel.
    - If the device does not have any BGP AS-path filters configured, the BGP AS Path Filter configuration panel is displayed, as shown in the following example.

- If BGP AS-path filters are already configured and you are adding a new one, click on the Add AS Path Filter link to display the BGP AS Path Filter configuration panel, as shown in the following example.
- If you are modifying an existing BGP AS-path filter, click on the Modify button to the right of the row describing the filter to display the BGP AS Path Filter configuration panel, as shown in the following example.



5. Enter the filter ID in the ID field. You can specify a number from 1 – 100.
6. Select the action you want the routing switch to perform if the filter is true:
   - If you select Deny, the router denies the route from entering the BGP4 table if the filter match is true.
   - If you select Permit, the router permits the route into the BGP4 table if the filter match is true.
7. Enter the AS path you want to filter in the Regular Expression field. As indicated by the field's title, you can use regular expressions for the AS path. See "Using Regular Expressions" on page 10-49.
8. Click the Add button to apply the changes to the device's running-config file.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Defining an AS-Path ACL

To configure an AS-path ACL, use either of the following methods.

USING THE CLI

To configure an AS-path list that uses ACL 1, enter a command such as the following:

```
HP9300(config)# ip as-path access-list 1 permit 100
HP9300(config)# router bgp
HP9300(config-bgp-router)# neighbor 10.10.10.1 filter-list 1 in
```

The **ip as-path** command configures an AS-path ACL that permits routes containing AS number 100 in their AS paths. The **neighbor** command then applies the AS-path ACL to advertisements and updates received from neighbor 10.10.10.1. In this example, the only routes the routing switch permits from neighbor 10.10.10.1 are those whose AS-paths contain AS-path number 100.

Syntax: ip as-path access-list <num> [seq <seq-value>] deny | permit <as-regular-expression>

The <num> parameter specifies the ACL number and can be from 1 – 199.

The **seq** <seq-value> parameter is optional and specifies the AS-path list's sequence number. You can configure up to 199 entries in an AS-path list. If you do not specify a sequence number, the software numbers them in increments of 5, beginning with number 5. The software interprets the entries in an AS-path list in numerical order, beginning with the lowest sequence number.

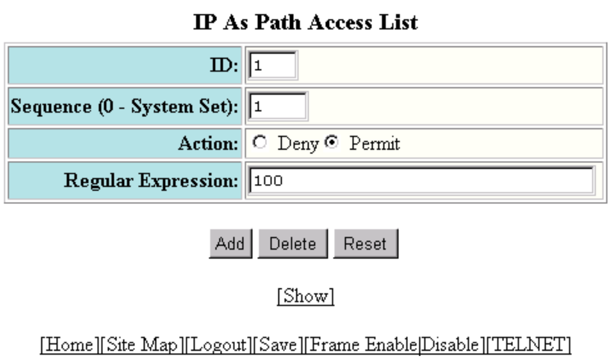
The **deny | permit** parameter specifies the action the software takes if a route's AS-path list matches a match statement in this ACL. To configure the AS-path match statements, use the **match as-path** command. See "Matching Based on AS-Path ACL" on page 10-63.

The <as-regular-expression> parameter specifies the AS path information you want to permit or deny to routes that match any of the match statements within the ACL. You can enter a specific AS number or use a regular expression. For the regular expression syntax, see “Using Regular Expressions” on page 10-49.

The **neighbor** command uses the **filter-list** parameter to apply the AS-path ACL to the neighbor. See “Adding BGP4 Neighbors” on page 10-14.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the list of configuration options.
3. Click on the plus sign next to IP to display the list of IP configuration options.
4. Select the AS Path Access List link.
    - If the device does not have any AS Path ACLs, the IP AS Path Access List panel is displayed, as shown in the following example.
    - If an AS Path ACL is already configured and you are adding a new one, click on the Add AS Path Access List link to display the IP AS Path Access List panel, as shown in the following example.



NOTE: You cannot modify an AS Path ACL. Instead, you can delete and then re-add the ACL. To delete an ACL, click on the Delete button to the right of the row describing the ACL, then click on the Add AS Path Access List link.

5. Edit the ACL ID in the ID field, if needed. You can enter a number from 1 – 199.
6. Edit the number in the sequence number in the Sequence field, if you want to override the automatically generated sequence number. You can configure up to 199 entries in an AS-path list. If you do not specify a sequence number, the software numbers them in increments of 5, beginning with number 5. The software interprets the entries in an AS-path list in numerical order, beginning with the lowest sequence number.
7. Select the action you want the software to perform if a route’s AS path list matches this ACL entry. You can select Deny or Permit.
8. Enter a regular expression to specify the AS path information you want to permit or deny to routes that match this ACL entry. You can enter a specific AS number or use a regular expression. For the regular expression syntax, see “Using Regular Expressions” on page 10-49.
9. Click the Add button to save the change to the device’s running-config file.
10. Repeat steps 6 – 9 for each entry in the ACL. To create another AS Path ACL, go to step 5.
11. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

NOTE: You cannot apply the AS path ACLs to a neighbor using the Web management interface. You must use the CLI. The AS Path Filter List for Weight field in the BGP Neighbor panel of the Web management interface is not used for AS path filtering, but is instead used for changing a route's weight based on the AS path list.

Using Regular Expressions

You use a regular expression for the <as-path> parameter to specify a single character or multiple characters as a filter pattern. If the AS-path matches the pattern specified in the regular expression, the filter evaluation is true; otherwise, the evaluation is false.

In addition, you can include special characters that influence the way the software matches the AS-path against the filter value.

To filter on a specific single-character value, enter the character for the <as-path> parameter. For example, to filter on AS-paths that contain the letter "z", enter the following command:

```
HP9300(config-bgp-router)# as-path-filter 1 permit z
```

To filter on a string of multiple characters, enter the characters in brackets. For example, to filter on AS-paths that contain "x", "y", or "z", enter the following command:

```
HP9300(config-bgp-router)# as-path-filter 1 permit [xyz]
```

Special Characters

When you enter as single-character expression or a list of characters, you also can use the following special characters. Table 10.2 on page 10-49 lists the special characters. The description for each special character includes an example. Notice that you place some special characters in front of the characters they control but you place other special characters after the characters they control. In each case, the examples show where to place the special character.

Table 10.2: BGP4 Special Characters for Regular Expressions

Character	Operation
.	The period matches on any single character, including a blank space. For example, the following regular expression matches for "aa", "ab", "ac", and so on, but not just "a". a.
*	The asterisk matches on zero or more sequences of a pattern. For example, the following regular expression matches on an AS-path that contains the string "1111" followed by any value: 1111*
+	The plus sign matches on one or more sequences of a pattern. For example, the following regular expression matches on an AS-path that contains a sequence of "g"s, such as "deg", "degg", "deggg", and so on: deg+
?	The question mark matches on zero occurrences or one occurrence of a pattern. For example, the following regular expression matches on an AS-path that contains "dg" or "deg": de?g

Table 10.2: BGP4 Special Characters for Regular Expressions (Continued)

Character	Operation
^	A caret (when not used within brackets) matches on the beginning of an input string. For example, the following regular expression matches on an AS-path that begins with “jlampa”: ^jlampa
$	A dollar sign matches on the end of an input string. For example, the following regular expression matches on an AS-path that ends with “deg”: deg$
_	An underscore matches on one or more of the following: • **,** (comma) • **{** (left curly brace) • **}** (right curly brace) • **(** (left parenthesis) • **)** (right parenthesis) • The beginning of the input string • The end of the input string • A blank space For example, the following regular expression matches on “100” but not on “1002”, “2100”, and so on. _100_
[ ]	Square brackets enclose a range of single-character patterns. For example, the following regular expression matches on an AS-path that contains “1”, “2”, “3”, “4”, or “5”: [1-5] You can use the following expression symbols within the brackets. These symbols are allowed only inside the brackets. • **^ –** The caret matches on any characters *except* the ones in the brackets. For example, the following regular expression matches on an AS-path that does *not* contain “1”, “2”, “3”, “4”, or “5”: [^1-5] • **-** The hyphen separates the beginning and ending of a range of characters. A match occurs if any of the characters within the range is present. See the example above.
|	A vertical bar (sometimes called a pipe or a “logical or”) separates two alternative values or sets of values. The AS-path can match one or the other value. For example, the following regular expression matches on an AS-path that contains either “abc” or “defg”: (abc)|(defg) **Note**: The parentheses group multiple characters to be treated as one value. See the following row for more information about parentheses.

Table 10.2: BGP4 Special Characters for Regular Expressions (Continued)

<table>
<tr><th>Character</th><th>Operation</th></tr>
<tr><td>( )</td><td>Parentheses allow you to create complex expressions. For example, the following complex expression matches on “abc”, “abcabc”, or “abcabcabcdefg”, but not on “abcdefgdefg”:
((abc)+)|((defg)?)</td></tr>
</table>

If you want to filter for a special character instead of using the special character as described in Table 10.2 on page 10-49, enter “****” (backslash) in front of the character. For example, to filter on AS-path strings containing an asterisk, enter the asterisk portion of the regular expression as “*****”.

```
HP9300(config-bgp-router)# as-path-filter 2 deny \*
```

To use the backslash as a string character, enter two slashes. For example, to filter on AS-path strings containing a backslash, enter the backslash portion of the regular expression as “****”.

```
HP9300(config-bgp-router)# as-path-filter 2 deny \\
```

Filtering Communities

You can filter routes received from BGP4 neighbors based on community names. Use either of the following methods to do so.

A community is an optional attribute that identifies the route as a member of a user-defined class of routes. Community names are arbitrary values made of two five-digit integers joined by a colon. You determine what the name means when you create the community name as one of a route’s attributes. Each string in the community name can be a number from 0 – 65535.

This format allows you to easily classify community names. For example, a common convention used in community naming is to configure the first string as the local AS and the second string as the unique community within that AS. Using this convention, communities 1:10, 1:20, and 1:30 can be easily identified as member communities of AS 1.

The routing switch provides the following methods for filtering on AS-path information:

- Community filters
- Community list ACLs

NOTE: The routing switch cannot actively support community filters and community list ACLs at the same time. Use one method or the other but do not mix methods.

NOTE: Once you define a filter or ACL, the default action for communities that do not match a filter or ACL is “deny”. To change the default action to “permit”, configure the last filter or ACL entry as “permit any any”.

Community filters or ACLs can be referred to by match statements in a route map.

Defining a Community Filter

USING THE CLI

To define filter 3 to permit routes that have the NO_ADVERTISE community, enter the following command:

```
HP9300(config-bgp-router)# community-filter 3 permit no-advertise
```

Syntax: community-filter <num> permit | deny <num>:<num> | internet | local-as | no-advertise | no-export

The <num> parameter identifies the filter’s position in the community filter list and can be from 1 – 100. Thus, the community filter list can contain up to 100 filters. The router applies the filters in numerical order, beginning with the lowest-numbered filter. When a filter match is true, the router stops and does not continue applying filters from the list.

NOTE: If the filter is referred to by a route map's match statement, the filter is applied in the order in which the filter is listed in the match statement.

The **permit | deny** parameter indicates the action the router takes if the filter match is true.

- If you specify **permit**, the router permits the route into the BGP4 table if the filter match is true.
- If you specify **deny**, the router denies the route from entering the BGP4 table if the filter match is true.

The <num>:<num> parameter indicates a specific community number to filter. Use this parameter to filter for a private (administrator-defined) community. You can enter up to 20 community numbers with the same command.

If you want to filter for the well-known communities "LOCAL_AS", "NO_EXPORT" or "NO_ADVERTISE", use the corresponding keyword (described below).

The **internet** keyword checks for routes that do not have the community attribute. Routes without a specific community are considered by default to be members of the largest community, the Internet.

The **local-as** keyword checks for routes with the well-known community "LOCAL_AS". This community applies only to confederations. The routing switch advertises the route only within the sub-AS. For information about confederations, see "Configuring Confederations" on page 10-36.

The **no-advertise** keyword filters for routes with the well-known community "NO_ADVERTISE". A route in this community should not be advertised to any BGP4 neighbors.

The **no-export** keyword filters for routes with the well-known community "NO_EXPORT". A route in this community should not be advertised to any BGP4 neighbors outside the local AS. If the router is a member of a confederation, the routing switch advertises the route only within the confederation. For information about confederations, see "Configuring Confederations" on page 10-36.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Community Filter link to display the BGP Community Filter panel.

   NOTE: If the device already has community filters, a table listing the filters is displayed. Click the Modify button to the right of the row describing a filter to change its configuration, or select the Add Community Filter link to display the BGP Community Filter panel.

5. Enter the filter's position in the ID filter. The ID is the filter's position in the community filter list and can be from 1 – 100. Thus, the community filter list can contain up to 100 filters. The router applies the filters in numerical order, beginning with the lowest-numbered filter. When a filter match is true, the router stops and does not continue applying filters from the list.

   If the filter is referred to by a route map's match statement, the filter is applied in the order in which the filter is listed in the match statement.

6. Select the action for the filter. You can select Deny or Permit:
   - If you select Deny, the router denies the route from entering the BGP4 table if the filter match is true.
   - If you select Permit, the router permits the route into the BGP4 table if the filter match is true.
7. Specify a well-known community you want the routing switch to apply to a route when the route matches the filter by selecting from the following:
   - Internet – Filters for routes that do not have the community attribute. Routes without a specific community are considered by default to be members of the largest community, the Internet.
   - Local AS – Filters for routes with the well-known community "LOCAL_AS". A route in this community

should not be advertised outside the sub-AS. This community type applies to confederations.

- No Advertise – Filters for routes with the well-known community “NO_ADVERTISE”. A route in this community should not be advertised to any BGP4 neighbors.
- No Export – Filters for routes with the well-known community “NO_EXPORT”. A route in this community should not be advertised to any BGP4 neighbors outside the local AS. If the router is a member of a confederation, the routing switch advertises the route only within the confederation.

NOTE: If you want to filter on a private (administrator-defined) community, do not select one of these. Instead, enter the community number in the Community List field.

---

8. Specify private communities by entering the community names in the Community List field. Enter the names in the following format <num>:<num>. You can use commas or spaces to separate the names.
9. Click the Add button (if you are adding a new filter) or the Modify button (if you are changing a filter) to apply the changes to the device’s running-config file.
10. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Defining a Community ACL

To configure a community ACL, use either of the following methods.

USING THE CLI

To configure community ACL 1, enter a command such as the following:

```
HP9300(config)# ip community-list 1 permit 123:2
```

This command configures a community ACL that permits routes that contain community 123:2.

NOTE: See “Matching Based on Community ACL” on page 10-65 for information about how to use a community list as a match condition in a route map.

Syntax: ip community-list <num> [seq <seq-value>] deny | permit <community-num>

The <num> parameter specifies the ACL number and can be from 1 – 199.

The **seq** <seq-value> parameter is optional and specifies the community list’s sequence number. You can configure up to 199 entries in a community list. If you do not specify a sequence number, the software numbers them in increments of 5, beginning with number 5. The software interprets the entries in a community list in numerical order, beginning with the lowest sequence number.

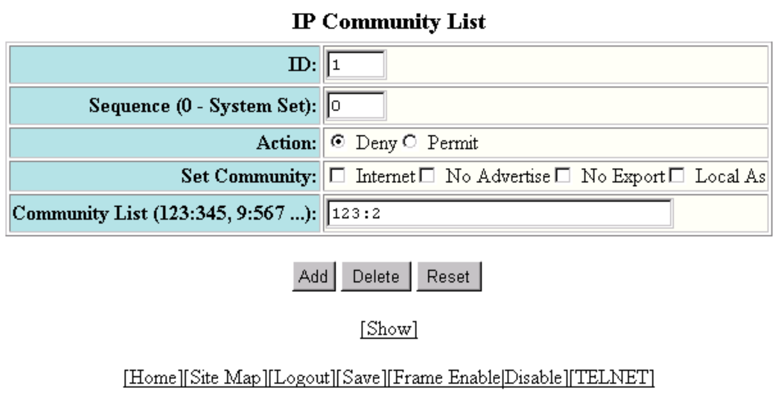
The **deny | permit** parameter specifies the action the software takes if a route’s community list matches a match statement in this ACL. To configure the community-list match statements, use the **match community** command. See “Matching Based on Community ACL” on page 10-65.

The <community-num> parameter specifies the community type or community number. This parameter can have the following values:

- <num>**:**<num> – A specific community number
- **internet** – The Internet community
- **no-export** – The community of sub-ASs within a confederation. Routes with this community can be exported to other sub-ASs within the same confederation but cannot be exported outside the confederation to other ASs or otherwise sent to EBGP neighbors.
- **local-as** – The local sub-AS within the confederation. Routes with this community can be advertised only within the local subAS.
- **no-advertise** – Routes with this community cannot be advertised to any other BGP4 routers at all.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the list of configuration options.
3. Click on the plus sign next to IP to display the list of IP configuration options.
4. Select the Community Access List link.
   - If the device does not have any community ACLs, the IP Community List panel is displayed, as shown in the following example.
   - If a community ACL is already configured and you are adding a new one, click on the Add Community Access List link to display the IP Community List panel, as shown in the following example.



NOTE: You cannot modify a community ACL. Instead, you can delete and then re-add the ACL. To delete an ACL, click on the Delete button to the right of the row describing the ACL, then click on the Add Community List link.

---

5. Edit the ACL ID in the ID field, if needed. You can enter a number from 1 – 199.
6. Edit the number in the sequence number in the Sequence field, if you want to override the automatically generated sequence number. You can configure up to 199 entries in a community list. If you do not specify a sequence number, the software numbers them in increments of 5, beginning with number 5. The software interprets the entries in ascending sequence order.
7. Select the action you want the software to perform if a route's community list matches this ACL entry.
8. Select the community type by clicking on the checkbox to the left of the description, or enter the community numbers in the Community List field.
9. Click the Add button to save the change to the device's running-config file.
10. Repeat steps 6 – 9 for each entry in the ACL. To create another community ACL, go to step 5.
11. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

NOTE: You cannot apply the community list ACLs to a neighbor using the Web management interface. You must use the CLI.

Defining IP Prefix Lists

An IP prefix list specifies a list of networks. When you apply an IP prefix list to a neighbor, the routing switch sends or receives only a route whose destination is in the IP prefix list. You can configure up to 100 prefix lists. The software interprets the prefix lists in order, beginning with the lowest sequence number.

USING THE CLI

To configure an IP prefix list and apply it to a neighbor, enter commands such as the following:

```
HP9300(config)# ip prefix-list Routesfor20 permit 20.20.0.0/24
HP9300(config-bgp-router)# neighbor 10.10.10.1 prefix-list Routesfor20 out
```

These commands configure an IP prefix list named Routesfor20, which permits routes to network 20.20.0.0/24. The **neighbor** command configures the routing switch to use IP prefix list Routesfor20 to determine which routes to send to neighbor 10.10.10.1. The routing switch sends routes that go to 20.20.x.x to neighbor 10.10.10.1 because the IP prefix list explicitly permits these routes to be sent to the neighbor.

Syntax: ip prefix-list <name> [seq <seq-value>] [description <string>] deny | permit <network-addr>/<mask-bits> [ge <ge-value>] [le <le-value>]

The <name> parameter specifies the prefix list name. You use this name when applying the prefix list to a neighbor.

The **description** <string> parameter is a text string describing the prefix list.

The **seq** <seq-value> parameter is optional and specifies the IP prefix list's sequence number. You can configure up to 100 prefix list entries. If you do not specify a sequence number, the software numbers them in increments of 5, beginning with prefix list entry 5. The software interprets the prefix list entries in numerical order, beginning with the lowest sequence number.

The **deny | permit** parameter specifies the action the software takes if a neighbor's route is in this prefix list.

The prefix-list matches only on this network unless you use the **ge** <ge-value> or **le** <le-value> parameters. (See below.)

The <network-addr>/<mask-bits> parameter specifies the network number and the number of bits in the network mask.

You can specify a range of prefix length for prefixes that are more specific than <network-addr>/<mask-bits>.

- If you specify only **ge** <ge-value>, then the mask-length range is from <ge-value> to 32.
- If you specify only **le** <le-value>, then the mask-length range is from length to <le-value>.

The <ge-value> or <le-value> you specify must meet the following condition:

length < ge-value <= le-value <= 32

If you do not specify **ge** <ge-value> or **le** <le-value>, the prefix list matches only on the exact network prefix you specify with the <network-addr>/<mask-bits> parameter.

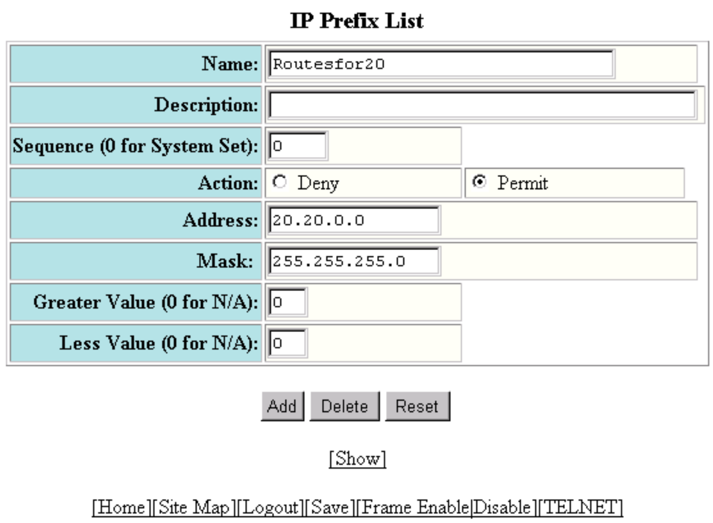
For the syntax of the **neighbor** command shown in the example above, see "Adding BGP4 Neighbors" on page 10-14.

USING THE WEB MANAGEMENT INTERFACE

To configure an IP Prefix List, use the following procedure:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the list of configuration options.
3. Click on the plus sign next to IP to display the list of IP configuration options.
4. Select the Prefix List link.
   - If the device does not have any prefix list ACLs, the IP Prefix List panel is displayed, as shown in the following example.

- If a prefix list ACL is already configured and you are adding a new one, click on the Add IP Prefix List link to display the IP Prefix List panel, as shown in the following example.



NOTE: You cannot modify an IP prefix list ACL. Instead, you can delete and then re-add the ACL. To delete an ACL, click on the Delete button to the right of the row describing the ACL, then click on the Add IP Prefix List link.

---

5. Edit a name in the Name field.
6. Enter a description in the Description field.
7. Edit the number in the sequence number in the Sequence field, if you want to override the automatically generated sequence number. You can configure up to 100 prefix list entries. If you do not specify a sequence number, the software numbers them in increments of 5, beginning with prefix list entry 5. The software interprets the prefix list entries in numerical order, beginning with the lowest sequence number.
8. Select the action you want the software to perform if a neighbor's route is in this prefix list.
9. Enter the IP prefix by entering a network address and sub-net mask in the Address and Mask fields.

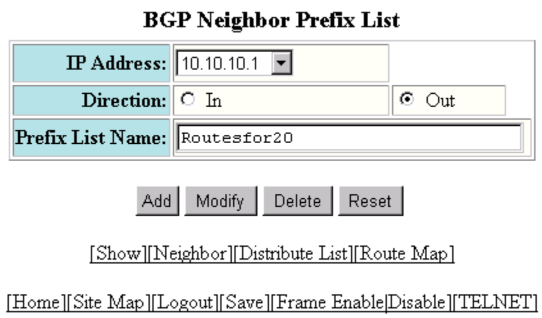
NOTE: If you do not specify a Greater Value or Less Value, this prefix list entry matches only on the exact network prefix you specified with the values in the Address and Mask fields.

---

10. Enter a number from 1 – 32 in the Greater Value field if you want the prefix list to match on prefixes that are more specific than the one you entered in the Address and Mask fields, in addition to matching on the prefix in those fields. The value you enter here specifies the minimum number of mask bits in the network mask. For example, if you enter 24 in the example panel shown above, the prefix list matches on all network numbers that are equal to or more specific than 20.20.0.0. Thus 20.20.1.0 and higher also match the prefix list.
11. Enter a number from 1 – 32 in the Less Value field if you want the prefix list to match on prefixes that are less specific than the one you entered in the Address and Mask fields, in addition to matching on the prefix in those fields.
12. Click the Add button to save the change to the device's running-config file.
13. Repeat steps 5 – 12 for each IP prefix list entry.
14. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

To apply the IP Prefix List to a neighbor, use the following procedure:

1. In the tree view, click on the plus sign next to BGP under Configure to display the list of BGP configuration options.
2. Select the Neighbor link to display the BGP Neighbor panel.
3. Select the Prefix List link to display the BGP Neighbor Prefix List panel, as shown in the following example.



4. Select the neighbor's IP address from the IP Address field's pulldown menu.

NOTE: The address appears in this menu only if you have already configured the neighbor information on the routing switch.

---

5. Select the direction to which you are applying the prefix list by clicking next to In or Out.
   - In – The prefix list applies to routes received from the neighbor.
   - Out – The prefix list applies to routes destined to be sent to the neighbor.
6. Enter the prefix list name or ID in the Prefix List Name field.
7. Click the Add button to save the change to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Defining Neighbor Distribute Lists

A neighbor distribute list is a list of BGP4 address filters or ACLs that filter the traffic to or from a neighbor. To configure a neighbor distribute list, use either of the following methods.

USING THE CLI

To configure a distribute list that uses ACL 1, enter a command such as the following:

```
HP9300(config-bgp-router)# neighbor 10.10.10.1 distribute-list 1 in
```

This command configures the routing switch to use ACL 1 to select the routes that the routing switch will accept from neighbor 10.10.10.1.

Syntax: neighbor <ip-addr> distribute-list <name-or-num> in | out

The <ip-addr> parameter specifies the neighbor.

The <name-or-num> parameter specifies the name or number of a standard, extended, or named ACL.

The **in | out** parameter specifies whether the distribute list applies to inbound or outbound routes:

- **in** – controls the routes the routing switch will accept from the neighbor.
- **out** – controls the routes sent to the neighbor.

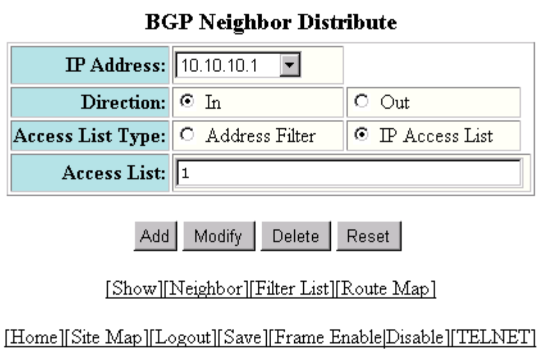
NOTE: The command syntax shown above is new beginning with software release 06.6.*X*. However, the **neighbor** <ip-addr> **distribute-list in | out** <num> command (where the direction is specified before the filter number) is the same as in earlier software releases. Use the new syntax when you are using an IP ACL or IP prefix list with the distribute list. Use the old syntax when you are using a BGP4 address filter with the distribute list.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Neighbor link to display the BGP Neighbor panel.

   NOTE: If the device already has neighbors, a table listing the neighbors is displayed. Click the Modify button to the right of the row describing the neighbor to change its configuration, or click the Add Neighbor link to display the BGP Neighbor configuration panel.

5. If you are adding a new neighbor or you need to change additional parameters, see the complete procedure in “Adding BGP4 Neighbors” on page 10-14.
6. Select the Distribute List link at the bottom of the panel to display the BGP Neighbor Distribute panel, as shown in the following example.



7. Select the neighbor’s IP address from the IP Address field’s pulldown menu.

   NOTE: The address appears in this menu only if you have already configured the neighbor information on the routing switch.

8. Select the direction to which you are applying the distribute list by clicking next to In or Out.
   - In – The distribute list applies to routes received from the neighbor.
   - Out – The distribute list applies to routes destined to be sent to the neighbor.
9. Select the type of distribute list you are applying. You can select one of the following:
   - Address Filter – a BGP4 address filter.
   - IP Access List – an ACL.
10. Enter the address filter or ACL name or ID in the Access List field.
11. Click the Add button to save the change to the device’s running-config file.

12. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Defining Route Maps

A ***route map*** is a named set of match conditions and parameter settings that the router can use to modify route attributes and to control redistribution of the routes into other protocols. A route map consists of a sequence of up to 50 ***instances***. If you think of a route map as a table, an instance is a row in that table. The router evaluates a route according to a route map's instances in ascending numerical order. The route is first compared against instance 1, then against instance 2, and so on. As soon as a match is found, the router stops evaluating the route against the route map instances.

Route maps can contain ***match*** statements and ***set*** statements. Each route map contains a "permit" or "deny" action for routes that match the match statements.

- If the route map contains a permit action, a route that matches a match statement is permitted; otherwise, the route is denied.
- If the route map contains a deny action, a route that matches a match statement is denied.
- If a route does not match any match statements in the route map, the route is denied. This is the default action. To change the default action, configure the last match statement in the last instance of the route map to "permit any any".
- If there is no match statement, the software considers the route to be a match.
- For route maps that contain address filters, AS-path filters, or community filters, if the action specified by a filter conflicts with the action specified by the route map, the route map's action takes precedence over the individual filter's action.

If the route map contains set statements, routes that are permitted by the route map's match statements are modified according to the set statements.

Match statements compare the route against one or more of the following:

- The route's BGP4 MED (metric)
- A sequence of AS-path filters
- A sequence of community filters
- A sequence of address filters
- The IP address of the next hop router
- The route's tag
- For OSPF routes only, the route's type (internal, external type-1, or external type-2)

For routes that match all of the match statements, the route map's set statements can perform one or more of the following modifications to the route's attributes:

- Prepend AS numbers to the front of the route's AS-path. By adding AS numbers to the AS-path, you can cause the route to be less preferred when compared to other routes on the basis of the length of the AS-path.
- Add a user-defined tag to the route or add an automatically calculated tag to the route.
- Set the community value.
- Set the local preference.
- Set the MED (metric).
- Set the IP address of the next hop router.
- Set the origin to IGP or INCOMPLETE.
- Set the weight.

For example, when you configure parameters for redistributing routes into RIP, one of the optional parameters is a route map. If you specify a route map as one of the redistribution parameters, the router will match the route against the match statements in the route map. If a match is found and if the route map contains set statements, the router will set attributes in the route according to the set statements.

To create a route map, you define instances of the map. Each instance is identified by a sequence number. A route map can contain up to 50 instances.

To define a route map, use the procedures in the following sections.

Entering the Route Map Into the Software

USING THE CLI

To add instance 1 of a route map named “GET_ONE” with a permit action, enter the following command.

```
HP9300(config)# route-map GET_ONE permit 1
HP9300(config-routemap GET_ONE)#
```

Syntax: route-map <map-name> permit | deny <num>

As shown in this example, the command prompt changes to the Route Map level. You can enter the match and set statements at this level. See “Specifying the Match Conditions” on page 10-61 and “Setting Parameters in the Routes” on page 10-66.

The <map-name> is a string of characters that names the map. Map names can be up to 32 characters in length. You can define up 50 route maps on the router.

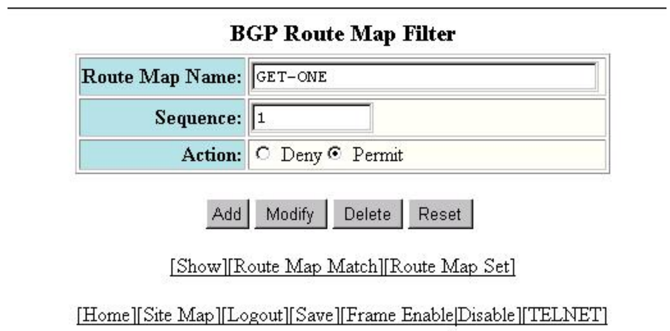
The **permit | deny** parameter specifies the action the router will take if a route matches a match statement.

- If you specify **deny**, the routing switch does not advertise or learn the route.
- If you specify **permit**, the routing switch applies the match and set statements associated with this route map instance.

The <num> parameter specifies the instance of the route map you are defining. Each route map can have up to 50 instances.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Route Map Filter link to display the BGP Route Map Filter panel.
    - If the device does not have any BGP route map filters configured, the BGP Route Map Filter configuration panel is displayed, as shown in the following example.
    - If BGP route map filters are already configured and you are adding a new one, click on the Route Map Filter link to display the BGP Route Map Filter configuration panel, as shown in the following example.
    - If you are modifying an existing BGP route map filter, click on the Modify button to the right of the row describing the filter to display the BGP Route Map Filter configuration panel, as shown in the following example.



5. Enter the name of the route map in the Route Map Name field.
6. Enter the sequence (instance) number in the Sequence field. The routing switch applies the instances in ascending numerical order. Once an instance comparison results in a "true" evaluation, the routing switch stops applying instances and applies the match and set statements you configure for the instance. See "Specifying the Match Conditions" on page 10-61 and "Setting Parameters in the Routes" on page 10-66.
7. Select the action you want the routing switch to perform if the comparison results in a "true" value:
   - If you select Deny, the routing switch does not advertise or learn the route.
   - If you select Permit, the routing switch applies the match and set statements associated with this route map instance.
8. Click the Add button to apply the changes to the device's running-config file.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Specifying the Match Conditions

Use the following command to define the match conditions for instance 1 of the route map GET_ONE. This instance compares the route updates against BGP4 address filter 11.

```
HP9300(config-bgp-routemap GET_ONE)# match address-filters 11
```

Syntax: match [as-path <num>] |
[address-filters | as-path-filters | community-filters <num,num,...>] |
[community <num>] |
[ip address | next-hop <acl-num> | prefix-list <string>] |
[metric <num>] |
[next-hop <address-filter-list>] |
[route-type internal | external-type1 | external-type2] |
[tag <tag-value>]

The **as-path** <num> parameter specifies an AS-path ACL. You can specify up to five AS-path ACLs. To configure an AS-path ACL, use the **ip as-path access-list** command. See "Defining an AS-Path ACL" on page 10-47.

The **address-filters | as-path-filters | community-filters** <num,num,...> parameter specifies a filter or list of filters to be matched for each route. The router treats the first match as the best match. If a route does not match any filter in the list, then the router considers the match condition to have failed. To configure these types of filters, use commands at the BGP configuration level.

- To configure an address filter, see "Filtering Specific IP Addresses" on page 10-44.
- To configure an AS-path filter or AS-path ACL, see "Filtering AS-Paths" on page 10-46.
- To configure a community filter or community ACL, see "Filtering Communities" on page 10-51.

You can enter up to six community names on the same command line.

NOTE: The filters must already be configured.

The **community** <num> parameter specifies a community ACL.

NOTE: The ACL must already be configured.

The **ip address | next-hop** <acl-num> | prefix-list <string> parameter specifies an ACL or IP prefix list. Use this parameter to match based on the destination network or next-hop gateway. To configure an IP ACL for use with this command, use the **ip access-list** command. See “Using Access Control Lists (ACLs)” on page 3-1. To configure an IP prefix list, use the **ip prefix-list** command. See “Defining IP Prefix Lists” on page 10-55.

The **metric** <num> parameter compares the route’s MED (metric) to the specified value.

The **next-hop** <address-filter-list> parameter compares the IP address of the route’s next hop to the specified IP address filters. The filters must already be configured.

The **route-type internal | external-type1 | external-type2** parameter applies only to OSPF routes. This parameter compares the route’s type to the specified value.

The **tag** <tag-value> parameter compares the route’s tag to the specified value.

USING THE WEB MANAGEMENT INTERFACE

NOTE: To simplify testing and configuration, you can specify an option and then choose whether to activate it. To activate an option, select the checkbox in front of the option’s field. Leave the checkbox unselected to leave the option inactive.

1. If you have just added the route map and the map is displayed in the BGP Route Map Filter panel, go to step 7. Otherwise, go to step 2.
2. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
5. Click on the Route Map Filter link to display a table listing the configured BGP route maps.
6. Click Modify next to the route map you want to configure to display the map in the BGP Route Map Filter panel.
7. Select the Route Map Match link at the bottom of the panel to display the BGP Route Map Match panel.
8. Select the sequence (instance) from the Route Map Name Sequence field’s pulldown list. The routing switch applies the instances in ascending numerical order and stops after the first match.
9. For OSPF routes, select the one of the following route types—Internal, External1, or External2.
10. Select the type of ACL or filter you are adding as a match condition. You can select more than one ACL or filter type. In this example, select AS Path Access List.

    NOTE: The AS-path, community, and address filters must already be configured.

    NOTE: The routing switch does not actively support both filters and ACLs at the same time. Use one method or the other.

    NOTE: IP prefix lists and neighbor distribute lists provide separate means for the same type of filtering. To simplify configuration, Hewlett-Packard recommends you use one method or the other but do not mix them.

11. Enter the filter or ACL numbers or names in the entry fields next to the filter or ACL types you selected.

12. Optionally enter an IP address against which you want to compare the route updates' next-hop attribute. Enter the address in the Next Hop List field. Also select the checkbox in front of the field.
13. Optionally enter a tag value against which you want to compare the updates in the Tag List field. Also select the checkbox in front of the field.
14. Optionally enter a MED (metric) value against which you want to compare the route updates in the Metric field. Also select the checkbox in front of the field.
15. Click the Apply button to apply the changes to the device's running-config file.
16. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Match Examples Using ACLs

The following sections show some detailed examples of how to configure route maps that include match statements that match on ACLs.

Matching Based on AS-Path ACL

To construct match statements for a route map that match based on AS-path information, use either of the following methods.

USING THE CLI

To construct a route map that matches based on AS-path ACL 1, enter the following commands:

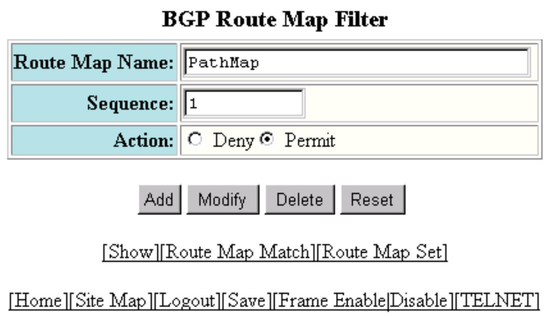
```
HP9300(config)# route-map PathMap permit 1
HP9300(config-routemap PathMap)# match as-path 1
```

Syntax: match as-path <num>

The <num> parameter specifies an AS-path ACL and can be a number from 1 – 199. You can specify up to five AS-path ACLs. To configure an AS-path ACL, use the **ip as-path access-list** command. See "Defining an AS-Path ACL" on page 10-47.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Route Map Filter link to display the BGP Route Map Filter panel.
   - If the device does not have any BGP route map filters configured, the BGP Route Map Filter configuration panel is displayed, as shown in the following example.
   - If BGP route map filters are already configured and you are adding a new one, click on the Route Map Filter link to display the BGP Route Map Filter configuration panel, as shown in the following example.
   - If you are modifying an existing BGP route map filter, click on the Modify button to the right of the row describing the filter to display the BGP Route Map Filter configuration panel, as shown in the following example.



5. Enter the name of the route map in the Route Map Name field.

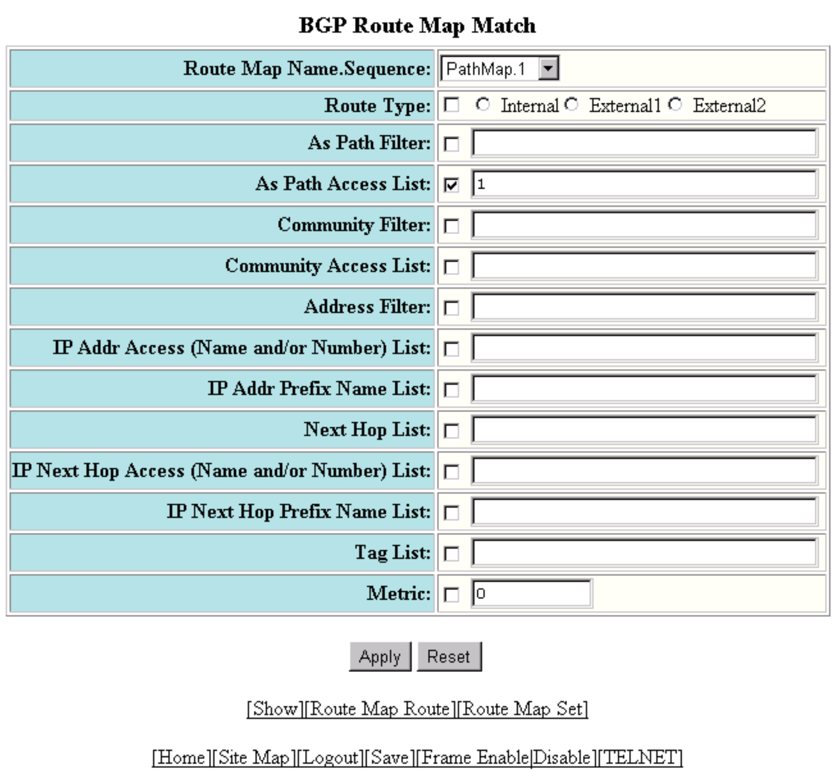
6. Enter the sequence (instance) number in the Sequence field. The routing switch applies the instances in ascending numerical order. Once an instance comparison results in a “true” evaluation, the routing switch stops applying instances and applies the match and set statements you configure for the instance.

7. Select the action you want the routing switch to perform if the comparison results in a “true” value:

   - If you select Deny, the routing switch does not advertise or learn the route.
   - If you select Permit, the routing switch applies the match and set statements associated with this route map instance.

8. Click the Add button to apply the changes to the device’s running-config file.

9. Select the Route Map Match link at the bottom of the panel to display the BGP Route Map Match panel, as shown in the following example.



10. Select the type of ACL or filter you are adding as a match condition. You can select more than one ACL or filter type. In this example, select AS Path Access List.

NOTE: IP prefix lists and neighbor distribute lists provide separate means for the same type of filtering. To simplify configuration, Hewlett-Packard recommends you use one method or the other but do not mix them.

11. Next to each type of ACL or filter you selected, enter the ACL or filter name or ID. In this example, AS-path ACL 1 is specified.
12. Click the Apply button to save the change to the device's running-config file.
13. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Matching Based on Community ACL

To construct match statements for a route map that match based on community information, use either of the following methods.

USING THE CLI

To construct a route map that matches based on community ACL 1, enter the following commands:

```
HP9300(config)# ip community-list 1 permit 123:2
HP9300(config)# route-map CommMap permit 1
HP9300(config-routemap CommMap)# match community 1
```

Syntax: match community <num>

The <num> parameter specifies a community list ACL and can be a number from 1 – 199. To configure a community list ACL, use the **ip community-list** command. See "Defining a Community ACL" on page 10-53.

USING THE WEB MANAGEMENT INTERFACE

Use the procedure in "Matching Based on AS-Path ACL" on page 10-63, but select Community Access List instead of AS Path Access List.

Matching Based on Destination Network

To construct match statements for a route map that match based on destination network, use either of the following methods. You can use the results of an IP ACL or an IP prefix list as the match condition.

USING THE CLI

To construct a route map that matches based on destination network, enter commands such as the following:

```
HP9300(config)# route-map NetMap permit 1
HP9300(config-routemap NetMap)# match ip address 1
```

Syntax: match ip address <name-or-num>

Syntax: match ip address prefix-list <name>

The <name-or-num> parameter with the first command specifies an IP ACL and can be a number from 1 – 199 or the ACL name if it is a named ACL. To configure an IP ACL, use the **ip access-list** or **access-list** command. See "Using Access Control Lists (ACLs)" on page 3-1.

The <name> parameter with the second command specifies an IP prefix list name. To configure an IP prefix list, see "Defining IP Prefix Lists" on page 10-55.

USING THE WEB MANAGEMENT INTERFACE

Use the procedure in "Matching Based on AS-Path ACL" on page 10-63, but select IP Addr Access (Name and/or Number) List instead of AS Path Access List.

Matching Based on Next-Hop Router

To construct match statements for a route map that match based on the IP address of the next-hop router, use either of the following methods. You can use the results of an IP ACL or an IP prefix list as the match condition.

USING THE CLI

To construct a route map that matches based on the next-hop router, enter commands such as the following:

```
HP9300(config)# route-map HopMap permit 1
HP9300(config-routemap HopMap)# match ip next-hop 2
```

Syntax: match ip next-hop <num>

Syntax: match ip next-hop prefix-list <name>

The <num> parameter with the first command specifies an IP ACL and can be a number from 1 – 199 or the ACL name if it is a named ACL. To configure an IP ACL, use the **ip access-list** or **access-list** command. See "Using Access Control Lists (ACLs)" on page 3-1.

The <name> parameter with the second command specifies an IP prefix list name. To configure an IP prefix list, see "Defining IP Prefix Lists" on page 10-55.

USING THE WEB MANAGEMENT INTERFACE

Use the procedure in "Matching Based on AS-Path ACL" on page 10-63, but select IP Next Hop Access (Name and/or Number) List instead of AS Path Access List.

Setting Parameters in the Routes

Use the following command to define a set statement that prepends an AS number to the AS path on each route that matches the corresponding match statement.

```
HP9300(config-bgp-routemap GET_ONE)# set as-path prepend 65535
```

Syntax: set as-path [prepend <as-num,as-num,...>] | [automatic-tag] |
[community <num>:<num> | <num> | internet | local-as | no-advertise | no-export] |
[dampening [<half-life> <reuse> <suppress> <max-suppress-time>]]
[[default] interface null0] | [ip [default] next hop <ip-addr>]
[local-preference <num>] | [metric [+ | -]<num> | none] | [next-hop <ip-addr>] | [origin igp | incomplete] |
[tag <tag-value>] | [weight <num>]

The **as-path prepend** <num,num,...> parameter adds the specified AS numbers to the front of the AS-path list for the route.

The **automatic-tag** parameter calculates and sets an automatic tag value for the route.

NOTE: This parameter applies only to routes redistributed into OSPF.

The **community** parameter sets the community attribute for the route to the number or well-known type you specify.

The **dampening** [<half-life> <reuse> <suppress> <max-suppress-time>] parameter sets route dampening parameters for the route. The <half-life> parameter specifies the number of minutes after which the route's penalty becomes half its value. The <reuse> parameter specifies how low a route's penalty must become before the route becomes eligible for use again after being suppressed. The <suppress> parameter specifies how high a route's penalty can become before the routing switch suppresses the route. The <max-suppress-time> parameter specifies the maximum number of minutes that a route can be suppressed regardless of how unstable it is. For information and examples, see "Configuring Route Flap Dampening" on page 10-69.

The **[default] interface null0** parameter redirects the traffic to the null0 interface, which is the same as dropping the traffic. If you specify **default**, the route map redirects the traffic to the specified interface (the null interface in this case) only if the routing switch does not already have explicit routing information for the traffic. This option is used in Policy-Based Routing (PBR). See "Policy-Based Routing (PBR)" on page 3-24.

The **ip [default] next hop** <ip-addr> parameter sets the next-hop IP address for traffic that matches a match statement in the route map. If you specify **default**, the route map sets the next-hop gateway only if the routing switch does not already have explicit routing information for the traffic. This option is used in Policy-Based Routing (PBR). See "Policy-Based Routing (PBR)" on page 3-24.

The **local-preference** <num> parameter sets the local preference for the route. You can set the preference to a value from 0 – 4294967295.

The **metric** [+ | -]<num> | none parameter sets the MED (metric) value for the route. The default MED value is 0. You can set the preference to a value from 0 – 4294967295.

- **set metric** <num> – Sets the route's metric to the number you specify.
- **set metric +**<num> – Increases route's metric by the number you specify.
- **set metric -**<num> – Decreases route's metric by the number you specify.
- **set metric none** – Removes the metric from the route (removes the MED attribute from the BGP4 route).

The **next-hop** <ip-addr> parameter sets the IP address of the route's next hop router.

The **origin igp | incomplete** parameter sets the route's origin to IGP or INCOMPLETE.

The **tag** <tag-value> parameter sets the route's tag. You can specify a tag value from 0 – 4294967295.

NOTE: This parameter applies only to routes redistributed into OSPF.

NOTE: You also can set the tag value using a table map. The table map changes the value only when the routing switch places the route in the IP route table instead of changing the value in the BGP route table. See "Using a Table Map To Set the Tag Value" on page 10-68.

The **weight** <num> parameter sets the weight for the route. You can specify a weight value from 0 – 4294967295.

USING THE WEB MANAGEMENT INTERFACE

NOTE: To simplify testing and configuration, you can specify an option and then choose whether to activate it. To activate an option, select the checkbox in front of the option's field. Leave the checkbox unselected to leave the option inactive.

---

1. If you have just added the route map and the map is displayed in the BGP Route Map Filter panel, go to step 7. Otherwise, go to step 2.
2. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
5. Click on the <u>Route Map Filter</u> link to display a table listing the configured BGP route maps.
6. Click Modify next to the route map you want to configure to display the map in the BGP Route Map Filter panel.
7. Select the <u>Route Map Set</u> link at the bottom of the panel to display the BGP Route Map Set panel.
8. Select the sequence (instance) from the Route Map Name Sequence field's pulldown list.
9. Optionally select the origin. You can select IGP or Incomplete. Also select the checkbox in front of the field.
10. Optionally enter AS numbers to append to the AS path. Also select the checkbox in front of the field.
11. Optionally select Auto Tag. The routing switch calculates and sets an automatic tag value for the route.
12. If you did not select Auto Tag and you instead want to set the tag value manually, enter a tag value from 0 – 4294967295 in the Tag field. Also select the checkbox in front of the field.
13. Optionally select the community type and also select the checkbox.
14. For a private community, enter the community number in the Number field. You can enter more than one community. Use commas or spaces to separate the community names.
15. Select Additive of you want the Set statement to add the specified community.

16. Optionally enter a local preference in the Local Preference and also select the checkbox in front of the field. The default local preference is 100. You can set the preference to a value from 0 – 4294967295.
17. Optionally enter a metric (MED) in the Metric field and also select the checkbox in front of the field. The default MED value is 0. You can set the preference to a value from 0 – 4294967295.
18. Optionally enter the Next Hop IP address in the NextHop field and also select the checkbox in front of the field.
19. Optionally enter a weight in the Weight field and also select the checkbox in front of the field. You can specify a weight value from 0 – 4294967295.
20. Click the Apply button to apply the changes to the device's running-config file.
21. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Using a Table Map To Set the Tag Value

Route maps that contain set statements change values in routes when the routes are filtered by the route map. For inbound route maps (route maps that filter routes received from neighbors), this means that the routes are changed before they enter the BGP4 route table.

For tag values, if you do not want the value to change until a route enters the IP route table, you can use a table map to change the value. A table map is a route map that you have associated with the IP routing table. The routing switch applies the set statements for tag values in the table map to routes before adding them to the route table.

To configure a table map, you configure the route map, then identify it as a table map. The table map does not require separate configuration. You create it simply by calling an existing route map a table map. You can have one table map.

NOTE: Use table maps only for setting the tag value. Do not use table maps to set other attributes. To set other route attributes, use route maps or filters.

USING THE CLI

To create a route map and identify it as a table map, enter commands such as following. These commands create a route map that uses an address filter. For routes that match the address filter, the route map changes the tag value to 100. This route map is then identified as a table map. As a result, the route map is applied only to routes that the routing switch places in the IP route table. The route map is not applied to all routes. This example assumes that address filter 11 has already been configured.

```
HP9300(config)# route-map TAG_IP permit 1
HP9300(config-routemap TAG_IP)# match address-filters 11
HP9300(config-routemap TAG_IP)# set tag 100
HP9300(config-routemap TAG_IP)# router bgp
HP9300(config-bgp-router)# table-map TAG_IP
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Use the Web management procedures in "Defining Route Maps" on page 10-59 to create the route map.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
5. Click on the General link to display the BGP configuration panel.
6. Select the route map name from the Table Map field's pulldown menu.
7. Click the Apply button to apply the changes to the device's running-config file.

8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring Route Flap Dampening

A "route flap" is the change in a route's state, from up to down or down to up. When a route's state changes, the state change causes changes in the route tables of the routers that support the route. Frequent changes in a route's state can cause Internet instability and add processing overhead to the routers that support the route.

Route flap dampening is a mechanism that reduces the impact of route flap by changing a BGP4 router's response to route state changes. When route flap dampening is configured, the routing switch suppresses unstable routes until the route's state changes reduce enough to meet an acceptable degree of stability. The HP implementation of route flap dampening is based on RFC 2439.

Route flap dampening is disabled by default. You can enable the feature globally or on an individual route basis using route maps.

NOTE: The routing switch applies route flap dampening only to routes learned from EBGP neighbors.

The route flap dampening mechanism is based on penalties. When a route exceeds a configured penalty value, the routing switch stops using that route and also stops advertising it to other routers. The mechanism also allows a route's penalties to reduce over time if the route's stability improves. The route flap dampening mechanism uses the following parameters:

- Suppression threshold – Specifies the penalty value at which the routing switch stops using the route. Each time a route becomes unreachable or is withdrawn by a BGP4 UPDATE from a neighbor, the route receives a penalty of 1000. By default, when a route has a penalty value greater than 2000, the routing switch stops using the route. Thus, by default, if a route goes down more than twice, the routing switch stops using the route. You can set the suppression threshold to a value from 1 – 20000. The default is 2000.
- Half-life – Once a route has been assigned a penalty, the penalty decreases exponentially and decreases by half after the half-life period. The default half-life period is 15 minutes. The software reduces route penalties every five seconds. For example, if a route has a penalty of 2000 and does not receive any more penalties (it does not go down again) during the half-life, the penalty is reduced to 1000 after the half-life expires. You can configure the half-life to be from 1 - 45 minutes. The default is 15 minutes.
- Reuse threshold – Specifies the minimum penalty a route can have and still be suppressed by the routing switch. If the route's penalty falls below this value, the routing switch un-suppresses the route and can use it again. The software evaluates the dampened routes every ten seconds and un-suppresses the routes that have penalties below the reuse threshold. You can set the reuse threshold to a value from 1 - 20000. The default is 750.
- Maximum suppression time – Specifies the maximum number of minutes a route can be suppressed regardless of how unstable the route has been before this time. You can set the parameter to a value from 1 – 20000 minutes. The default is four times the half-life. When the half-life value is set to its default (15 minutes), the maximum suppression time defaults to 60 minutes.

You can configure route flap dampening globally or for individual routes using route maps. If you configure route flap dampening parameters globally and also use route maps, the settings in the route maps override the global values.

Globally Configuring Route Flap Dampening

To configure route flap dampening globally, use either of the following methods.

USING THE CLI

To enable route flap dampening using the default values, enter the following command:

```
HP9300(config-bgp-router)# dampening
```

Syntax: dampening [<half-life> <reuse> <suppress> <max-suppress-time>]

The <half-life> parameter specifies the number of minutes after which the route's penalty becomes half its value. The route penalty allows routes that have remained stable for a while despite earlier instability to eventually become eligible for use again. The decay rate of the penalty is proportional to the value of the penalty. After the half-life expires, the penalty decays to half its value. Thus, a dampened route that is no longer unstable can eventually become eligible for use again. You can configure the half-life to be from 1 - 45 minutes. The default is 15 minutes.

The <reuse> parameter specifies how low a route's penalty must become before the route becomes eligible for use again after being suppressed. You can set the reuse threshold to a value from 1 – 20000. The default is 750 (0.75, or three-fourths, of the penalty assessed for a one "flap").

The <suppress> parameter specifies how high a route's penalty can become before the routing switch suppresses the route. You can set the suppression threshold to a value from 1 – 20000. The default is 2000 (two "flaps").

The <max-suppress-time> parameter specifies the maximum number of minutes that a route can be suppressed regardless of how unstable it is. You can set the maximum suppression time to a value from 1 – 20000 minutes. The default is four times the half-life setting. Thus, if you use the default half-life of 15 minutes, the maximum suppression time is 60 minutes.

The following example shows how to change the dampening parameters.

```
HP9300(config-bgp-router)# dampening 10 200 2500 40
```

This command changes the half-life to 20 minutes, the reuse threshold to 200, the suppression threshold to 2500, and the maximum number of minutes a route can be dampened to 40.

NOTE: To change any of the parameters, you must specify all the parameters with the command. If you want to leave some parameters unchanged, enter their default values.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel.
5. Select (Next 4) Parameters next to Dampening, to indicate that you want to enable dampening. This selection also ensures that when you click Apply, the interface applies changes you make to the dampening parameters in the following four fields.
6. Edit the value in the Dampening Half Life field if you want to change the half life. The half like specifies the number of minutes after which the route's penalty becomes half its value. The route penalty allows routes that have remained stable for a while despite earlier instability to eventually become eligible for use again. The decay rate of the penalty is proportional to the value of the penalty. After the half-life. expires, the penalty decays to half its value. Thus, a dampened route that is no longer unstable can eventually become eligible for use again. You can configure the half-life to be from 1 - 45 minutes. The default is 15 minutes.
7. Edit the value in the Dampening Reuse field if you want to change the dampening reuse parameter. The dampening reuse parameter specifies how low a route's penalty must become before the route becomes eligible for use again after being suppressed. You can set the reuse threshold to a value from 1 – 20000. The default is 750 (0.75, or three-fourths, of the penalty assessed for a one "flap").
8. Edit the value in the Dampening Suppress field if you want to change the dampening suppress parameter. The dampening suppress parameter specifies how high a route's penalty can become before the routing switch suppresses the route. You can set the suppression threshold to a value from 1 – 20000. The default is 2000 (two "flaps").
9. Edit the value in the Dampening Max Suppress Time field if you want to change the maximum suppression parameter. The maximum suppression parameter specifies the maximum number of minutes that a route can be suppressed regardless of how unstable it is. You can set the maximum suppression time to a value from

1 – 20000 minutes. The default is four times the half-life setting. Thus, if you use the default half-life of 15 minutes, the maximum suppression time is 60 minutes.

10. Click the Apply button to apply the changes to the device’s running-config file.
11. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Using a Route Map To Configure Route Flap Dampening for Specific Routes

Route maps enable you to fine tune route flap dampening parameters for individual routes. To configure route flap dampening parameters using route maps, configure BGP4 address filters for each route you want to set the dampening parameters for, then configure route map entries that set the dampening parameters for those routes. The following sections show examples.

To configure route flap dampening for specific routes, use one of the following methods.

USING THE CLI

To configure address filters and a route map for dampening specific routes, enter commands such as the following:

```
HP9300(config)# router bgp
HP9300(config-bgp-router)# address-filter 9 permit 209.157.22.0 255.255.255.0
255.255.255.0 255.255.255.0
HP9300(config-bgp-router)# address-filter 10 permit 209.157.23.0 255.255.255.0
255.255.255.0 255.255.255.0
HP9300(config-bgp-router)# exit
HP9300(config)# route-map DAMPENING_MAP permit 9
HP9300(config-routemap DAMPENING_MAP)# match address-filters 9
HP9300(config-routemap DAMPENING_MAP)# set dampening 10 200 2500 40
HP9300(config-routemap DAMPENING_MAP)# exit
HP9300(config)# route-map DAMPENING_MAP permit 10
HP9300(config-routemap DAMPENING_MAP)# match address-filters 10
HP9300(config-routemap DAMPENING_MAP)# set dampening 20 200 2500 60
HP9300(config-routemap DAMPENING_MAP)# router bgp
HP9300(config-bgp-router)# dampening route-map DAMPENING_MAP
```

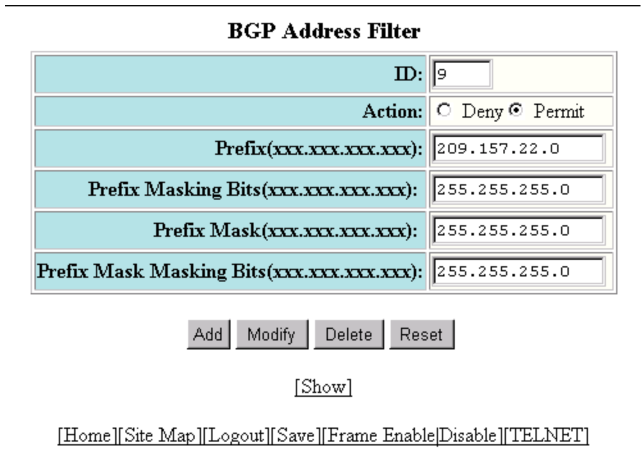
The **address-filter** commands in this example configure two BGP4 address filters, for networks 209.157.22.0 and 209.157.23.0. The first route-map command creates an entry in a route map called “DAMPENING_MAP”. Within this entry of the route map, the **match** command matches based on address filter 9, and the **set** command sets the dampening parameters for the route that matches. Thus, for BGP4 routes to 209.157.22.0, the routing switch uses the route map to set the dampening parameters. These parameters override the globally configured dampening parameters.

The commands for the second entry in the route map (instance 10 in this example) perform the same functions for route 209.157.23.0. Notice that the dampening parameters are different for each route.

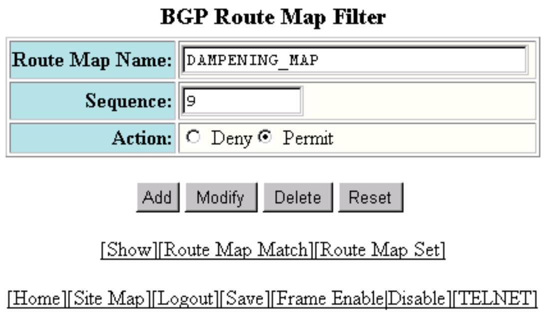
USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Address Filter link to display the BGP Address Filter panel.
   - If the device does not have any BGP address filters configured, the BGP Address Filter configuration panel is displayed, as shown in the following example.
   - If BGP address filters are already configured and you are adding a new one, click on the Add Address Filter link to display the BGP Address Filter configuration panel, as shown in the following example.

- If you are modifying an existing BGP address filter, click on the Modify button to the right of the row describing the filter to display the BGP Address Filter configuration panel, as shown in the following example.



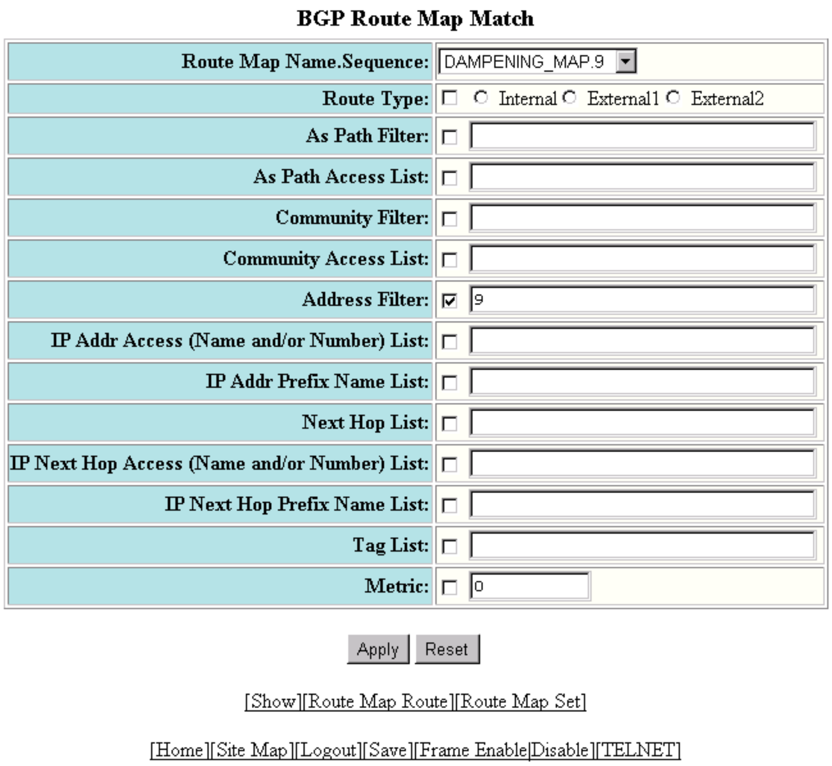
5. Enter the filter ID in the ID field. You can specify a number from 1 – 100.
6. Select the action you want the routing switch to perform if the filter is true:
   - If you select Deny, the router denies the route from entering the BGP4 table if the filter match is true.
   - If you select Permit, the router permits the route into the BGP4 table if the filter match is true.
7. Enter the network prefix in the Prefix field. If you specify “any”, all networks match the filter.
8. Enter the prefix masking bits in the Prefix Masking Bits field. The prefix masking bits indicate the bits in the prefix that the filter compares. The filter disregards the bits for which the mask contains zeros.
9. Enter the mask in the Prefix Mask field. If you specify “any”, all masks match the filter.
10. Enter the masking bits for the network mask in the Prefix Mask Masking Bits field.
11. Click the Add button to apply the changes to the device’s running-config file.
12. Repeat steps 5 – 11 for each address filter.
13. In the tree view, under BGP in the Configure section, click on the Route Map Filter link to display the BGP Route Map Filter panel.
   - If the device does not have any BGP route map filters configured, the BGP Route Map Filter configuration panel is displayed, as shown in the following example.
   - If BGP route map filters are already configured and you are adding a new one, click on the Route Map Filter link to display the BGP Route Map Filter configuration panel, as shown in the following example.
   - If you are modifying an existing BGP route map filter, click on the Modify button to the right of the row describing the filter to display the BGP Route Map Filter configuration panel, as shown in the following example.



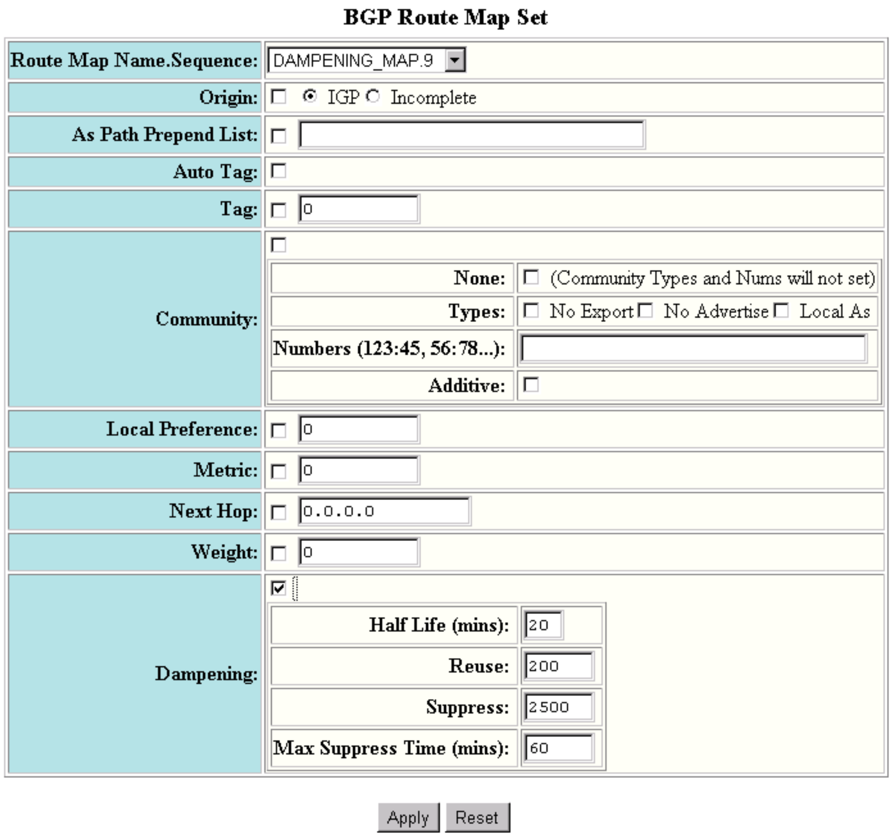
14. Enter the name of the route map in the Route Map Name field.
15. Enter the sequence (instance) number in the Sequence field. The routing switch applies the instances in ascending numerical order. Once an instance comparison results in a “true” evaluation, the routing switch stops applying instances and applies the match and set statements you configure for the instance.

NOTE: In this example, the sequence number matches the address filter number. Using the same number is a convenient way to remember that these configuration items are associated, but is not a requirement.

16. Select the action you want the routing switch to perform if the comparison results in a “true” value:
    - If you select Deny, the routing switch does not advertise or learn the route.
    - If you select Permit, the routing switch applies the match and set statements associated with this route map instance.
17. Click the Add button to apply the changes to the device’s running-config file.
18. Select the Route Map Match link at the bottom of the panel to display the BGP Route Map Match panel, as shown in the following example.



19. Click on the checkbox next to Address Filter to indicate that you are using an address filter as a match condition.
20. Enter the address filter number in the Address Filter field.
21. Click Apply to apply the changes to the device's running-config file.
22. Select the Route Map Set link at the bottom of the panel to display the BGP Route Map Set panel, as shown in the following example.



23. Select the checkbox in the Dampening section to specify that this route map is setting dampening parameters.
24. Edit the value in the Half Life field to specify the half life you want this route map to set for routes that match the match conditions you specified above.
25. Edit the value in the Reuse field to specify the dampening reuse value you want this route map to set.
26. Edit the value in the Suppress field to specify the dampening suppress value you want this route map to set.
27. Edit the value in the Max Suppress Time field to specify the maximum suppression value you want this route map to set.
28. Click Apply to apply the changes to the device's running-config file.
29. In the tree view, under BGP in the Configure section, click on the General link to display the BGP configuration panel.
30. In the Dampening section, click next to Route-Map, then select the dampening route map from the Route-Map field's pulldown menu. In this example, select the map named DAMPENING_MAP.

NOTE: The route map appears in this menu only if you have already configured the route map.

31. Click Apply to apply the changes to the device's running-config file.
32. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Using a Route Map To Configure Route Flap Dampening for a Specific Neighbor

You can use a route map to configure route flap dampening for a specific neighbor by performing the following tasks:

- Configure an empty route map with no match or set statements. This route map does not specify particular routes for dampening but does allow you to enable dampening globally when you refer to this route map from within the BGP configuration level.
- Configure another route map that explicitly enables dampening. Use a set statement within the route map to enable dampening. When you associate this route map with a specific neighbor, the route map enables dampening for all routes associated with the neighbor. You also can use match statements within the route map to selectively perform dampening on some routes from the neighbor.

NOTE: You still need to configure the first route map to enable dampening globally. The second route map does not enable dampening by itself; it just applies dampening to a neighbor.

- Apply the route map to the neighbor.

USING THE CLI

To enable route flap dampening for a specific BGP4 neighbor, enter commands such as the following:

```
HP9300(config)# route-map DAMPENING_MAP_ENABLE permit 1
HP9300(config-routemap DAMPENING_MAP_ENABLE)# exit
HP9300(config)# route-map DAMPENING_MAP_NEIGHBOR_A permit 1
HP9300(config-routemap DAMPENING_MAP_NEIGHBOR_A)# set dampening
HP9300(config-routemap DAMPENING_MAP_NEIGHBOR_A)# exit
HP9300(config)# router bgp
HP9300(config-bgp-router)# dampening route-map DAMPENING_MAP_ENABLE
HP9300(config-bgp-router)# neighbor 10.10.10.1 route-map in
DAMPENING_MAP_NEIGHBOR_A
```

In this example, the first command globally enables route flap dampening. This route map does not contain any match or set statements. At the BGP configuration level, the **dampening route-map** command refers to the DAMPENING_MAP_ENABLE route map created by the first command, thus enabling dampening globally.

The third and fourth commands configure a second route map that explicitly enables dampening. Notice that the route map does not contain a match statement. The route map implicitly applies to all routes. Since the route map will be applied to a neighbor at the BGP configuration level, the route map will apply to all routes associated with the neighbor.

Although the second route map enables dampening, the first route map is still required. The second route map enables dampening for the neighbors to which the route map is applied. However, unless dampening is already enabled globally by the first route map, the second route map has no effect.

The last two commands apply the route maps. The **dampening route-map** command applies the first route map, which enables dampening globally. The **neighbor** command applies the second route map to neighbor 10.10.10.1. Since the second route map does not contain match statements for specific routes, the route map enables dampening for all routes received from the neighbor.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. In the tree view, under BGP in the Configure section, click on the Route Map Filter link to display the BGP Route Map Filter panel.

NOTE: If the device already has route maps, a table listing the route maps is displayed. Click the Modify button to the right of the row describing the route map to change its configuration, or click the Add Route Map Filter link to display the BGP Route Map Filter panel.

---

5. Enter the name of the route map in the Route Map Name field. In this example, enter the name DAMPENING_MAP_ENABLE for the "empty" route map that you will use to globally enable dampening.
6. Enter the sequence (instance) number in the Sequence field or use the default value.
7. Select the action you want the routing switch to perform if the comparison results in a "true" value:
   - If you select Deny, the routing switch does not advertise or learn the route.
   - If you select Permit, the routing switch applies the match and set statements associated with this route map instance. In this example, select Permit.
8. Click the Add button to apply the changes to the device's running-config file.

NOTE: In this case, you are configuring an "empty" route map with no match or set statements, so you do not need to select the Route Map Match or Route Map Set link.

---

9. Enter the name of the route map you will use to set dampening parameters for a neighbor in the Route Map Name field. In this example, enter the name DAMPENING_MAP_NEIGHBOR_A.
10. Select the action you want the routing switch to perform if the comparison results in a "true" value:
    - If you select Deny, the routing switch does not advertise or learn the route.
    - If you select Permit, the routing switch applies the match and set statements associated with this route map instance. In this example, select Permit.
11. Click the Add button to apply the changes to the device's running-config file.
12. Select the Route Map Set link to display the BGP Route Map Set panel.

NOTE: If the interface displays a table listing the configured route maps, select the Route Map Set link under the table or click Modify next to the row describing the route map you are configuring.

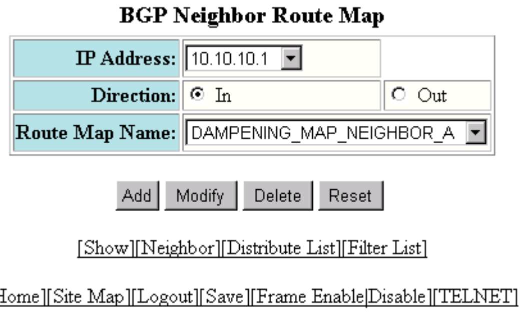
---

13. Select the route map name and sequence from the Route Map Name.Sequence field's pulldown menu.
14. Select the checkbox in the Dampening section to enable dampening for routes that match the route map.
15. Click the Apply button to apply the changes to the device's running-config file.
16. In the tree view, under BGP in the Configure section, click on the General link to display the BGP configuration panel.
17. In the Dampening section, click next to Route-Map, then select the dampening route map from the Route-Map field's pulldown menu. In this example, select the map named DAMPENING_MAP_ENABLE.

NOTE: The route map appears in this menu only if you have already configured the route map.

---

18. Click Apply to apply the changes to the device's running-config file.
19. In the tree view, under BGP in the Configure section, click on the Neighbor link to display the list of BGP neighbors.
20. Select the Modify button to the right of the row describing the neighbor to which you want to apply the dampening route map you configured in steps 9 – 15.
21. Select the Route Map link at the bottom of the panel to display the BGP Neighbor Route Map panel, as shown in the following example.



22. Select the neighbor IP address from the IP Address field's pulldown menu.
23. Select the traffic direction to which you want to apply the route map. You can select In or Out. In this example, select In.
24. Select the route map from the Route Map Name field's pulldown menu. In this example, select DAMPENING_MAP_NEIGHBOR_A.
25. Click Add to apply the changes to the device's running-config file.
26. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Removing Route Dampening from a Route

You can un-suppress routes by removing route flap dampening from the routes. The routing switch allows you to un-suppress all routes at once or un-suppress individual routes.

To un-suppress routes, use either of the following methods.

USING THE CLI

To un-suppress all the suppressed routes, enter the following command at the Privileged EXEC level of the CLI:

```
HP9300# clear ip bgp damping
```

Syntax: clear ip bgp damping [<ip-addr> <ip-mask>]

The <ip-addr> parameter specifies a particular network.

The <ip-mask> parameter specifies the network's mask.

To un-suppress a specific route, enter a command such as the following:

```
HP9300# clear ip bgp damping 209.157.22.0 255.255.255.0
```

This command un-suppresses only the route(s) for network 209.157.22.0/24.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Command in the tree view to expand the list of command options.
3. Click on the Clear link to display the Clear panel.
4. Select the checkbox next to BGP Dampening.
5. Specify the routes from which you want to remove dampening:
   - To clear dampening for all routes, select the All option.
   - To clear dampening for a specific route, select IP, then enter the network address and sub-net mask in the IP and Mask fields.

6. Click the Apply button to implement the change.

Displaying and Clearing Route Flap Dampening Statistics

The software provides many options for displaying and clearing route flap statistics. To display the statistics, use either of the following methods.

Displaying Route Flap Dampening Statistics

To display route flap dampening statistics, use the following CLI method.

USING THE CLI

To display route dampening statistics or all the dampened routes, enter the following command at any level of the CLI:

```
HP9300# show ip bgp flap-statistics

Total number of flapping routes: 414
    Status Code  >:best d:damped h:history *:valid
    Network            From            Flaps Since    Reuse    Path
h>  192.50.206.0/23    166.90.213.77   1     0 :0 :13 0 :0 :0  65001 4355 1 701
h>  203.255.192.0/20   166.90.213.77   1     0 :0 :13 0 :0 :0  65001 4355 1 7018
h>  203.252.165.0/24   166.90.213.77   1     0 :0 :13 0 :0 :0  65001 4355 1 7018
h>  192.50.208.0/23    166.90.213.77   1     0 :0 :13 0 :0 :0  65001 4355 1 701
h>  133.33.0.0/16      166.90.213.77   1     0 :0 :13 0 :0 :0  65001 4355 1 701
*>  204.17.220.0/24    166.90.213.77   1     0 :1 :4  0 :0 :0  65001 4355 701 62
```

Syntax: show ip bgp flap-statistics [regular-expression <regular-expression> | <address> <mask> [longer-prefixes] | neighbor <ip-addr>]

The **regular-expression** <regular-expression> parameter is a regular expression. The regular expressions are the same ones supported for BGP4 AS-path filters. See “Using Regular Expressions” on page 10-49.

The <address> <mask> parameter specifies a particular route. If you also use the optional **longer-prefixes** parameter, then all statistics for routes that match the specified route or have a longer prefix than the specified route are displayed. For example, if you specify **209.157.0.0 longer**, then all routes with the prefix 209.157. or that have a longer prefix (such as 209.157.22.) are displayed.

The **neighbor** <ip-addr> parameter displays route flap dampening statistics only for routes learned from the specified neighbor. You also can display route flap statistics for routes learned from a neighbor by entering the following command: **show ip bgp neighbor** <ip-addr> **flap-statistics**.

This display shows the following information.

Table 10.3: Route Flap Dampening Statistics

This Field...	Displays...
Total number of flapping routes	The total number of routes in the routing switch’s BGP4 route table that have changed state and thus have been marked as flapping routes.
Status code	Indicates the dampening status of the route, which can be one of the following: • > – This is the best route among those in the BGP4 route table to the route’s destination. • d – This route is currently dampened, and thus unusable. • h – The route has a history of flapping and is unreachable now. • * – The route has a history of flapping but is currently usable.

Table 10.3: Route Flap Dampening Statistics

This Field...	Displays...
Network	The destination network of the route.
From	The neighbor that sent the route to the routing switch.
Flaps	The number of flaps (state changes) the route has experienced.
Since	The amount of time since the first flap of this route.
Reuse	The amount of time remaining until this route will be un-suppressed and thus be usable again.
Path	Shows the AS-path information for the route.

You also can display all the dampened routes by entering the following command:
show ip bgp dampened-paths.

USING THE WEB MANAGEMENT INTERFACE

You cannot display dampening statistics using the Web management interface.

Clearing Route Flap Dampening Statistics

To clear route flap dampening statistics, use the following CLI method.

NOTE: Clearing the dampening statistics for a route does not change the dampening status of the route.

USING THE CLI

To clear all the route dampening statistics, enter the following command at any level of the CLI:

```
HP9300# clear ip bgp flap-statistics
```

Syntax: clear ip bgp flap-statistics [regular-expression <regular-expression> | <address> <mask> | neighbor <ip-addr>]

The parameters are the same as those for the **show ip bgp flap-statistics** command (except the **longer-prefixes** option is not supported). See “Displaying Route Flap Dampening Statistics” on page 10-79.

NOTE: The **clear ip bgp damping** command not only clears statistics but also un-suppresses the routes. See “Displaying Route Flap Dampening Statistics” on page 10-79.

USING THE WEB MANAGEMENT INTERFACE

You cannot clear dampening statistics using the Web management interface.

Statically Allocating Memory for the HP 6308M-SX Routing Switch

NOTE: These procedures apply only to the HP 6308M-SX. The HP 6308M-SX uses static memory allocation for BGP4.

Changing the Maximum Number of Neighbors

You can change the maximum number of BGP4 neighbors the HP 6308M-SX routing switch can have using either of the following methods.

NOTE: If you have a lot of IBGP neighbors, you can configure some IBGP routers as route reflectors. By doing so, you can reduce the number of neighbors you need to configure on each router. Without route reflectors, all IBGP routers must be fully meshed to ensure proper route propagation. See “Configuring Route Reflection Parameters” on page 10-33.

USING THE CLI

To change the maximum number of BGP4 neighbors to 3, enter the following command:

```
HP6308(config-bgp-router)# max-neighbors 3
HP6308(config-bgp-router)# end
HP6308# reload
```

Syntax: max-neighbors <num>

The <num> indicates the number of BGP4 neighbors allowed. See “Memory Considerations” on page 10-9 for the maximum for your device. The change takes effect after the router is rebooted.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.
5. Change the number in the Maximum Neighbors field. The maximum number you can enter depends on the device you are configuring. See “Memory Considerations” on page 10-9 for the maximum for your device.
6. Click the Apply button to apply the changes to the device’s running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.
8. Click on Command in the tree view to list the command options.
9. Select the Reload link and click on Yes when prompted. You must reload the software to place this configuration change into effect.

Changing the Maximum Number of Routes

You can change the maximum number of BGP4 routes the router can have using either of the following methods.

NOTE: This value also determines the maximum value you can configure when specifying how many routes this routing switch can learn from all its neighbors. See the description of the maximum prefix option in “Adding BGP4 Neighbors” on page 10-14.

USING THE CLI

To change the maximum number of BGP4 routes to 30000, enter the following command:

```
HP6308(config-bgp-router)# max-routes 30000
HP6308(config-bgp-router)# end
HP6308# reload
```

Syntax: max-routes <num>

The <num> indicates the number of BGP4 routes allowed. See “Memory Considerations” on page 10-9 for the maximum for your device. The change takes effect after the router is rebooted.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.
5. Change the number in the Maximum Routes field. The maximum number you can enter depends on the device you are configuring. See “Memory Considerations” on page 10-9 for the maximum for your device.
6. Click the Apply button to apply the changes to the device’s running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.
8. Click on Command in the tree view to list the command options.
9. Select the Reload link and click on Yes when prompted. You must reload the software to place this configuration change into effect.

Changing the Maximum Number of Route-Attribute Entries

The BGP4 route table lists the route attributes associated with each route in the table. These attributes include the following:

- IP address of the next hop router
- Metric
- Local Preference
- Origin
- Communities
- and others

A collection of these attributes is called a ***route-attributes entry***. Each route-attributes entry is a unique set of values for these attributes. For example, the following set of attribute values is a route-attributes entry:

```
Next Hop  :192.168.11.1       Metric   :0              Origin:IGP
Originator:0.0.0.0            Cluster List:None
Aggregator:AS Number :0       Router-ID:0.0.0.0        Atomic:FALSE
Local Pref:100                Communities:Internet
```

A route-attribute entry can be used by one or more routes. For example, if the first and second routes listed in the BGP4 route table use exactly the same set of attribute values, the routes both would use a single route-attributes entry. If any of the attributes differs for the two routes, each route would use a separate route-attributes entry. See “Displaying BGP4 Route-Attribute Entries” on page 10-109 for a description of the route-attribute fields shown in the example above.

You can change the maximum number of route-attribute entries the router can contain using either of the following methods.

USING THE CLI

To change the maximum number of route-attribute entries to 2500, enter the following command:

```
HP6308(config-bgp-router)# max-attribute-entries 2500
HP6308(config-bgp-router)# end
```

```
HP6308# reload
```

Syntax: max-attribute-entries <num>

The <num> indicates the number of route-attribute entries allowed on the router. See “Memory Considerations” on page 10-9 for the maximum for your device. The change takes effect after the router is rebooted.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the General link to display the BGP configuration panel, shown in Figure 10.2 on page 10-8.
5. Change the number in the Maximum Attribute Entries field. The maximum number you can enter depends on the device you are configuring. See “Memory Considerations” on page 10-9 for the maximum for your device.
6. Click the Apply button to apply the changes to the device’s running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.
8. Click on Command in the tree view to list the command options.
9. Select the Reload link and click on Yes when prompted. You must reload the software to place this configuration change into effect.

Displaying BGP4 Information

You can display the following configuration information and statistics for the BGP4 protocol on the router:

- Summary BGP4 configuration information for the router
- Active BGP4 configuration information (the BGP4 information in the running-config)
- Information about the router's BGP4 neighbors
- Information about the paths from which BGP4 selects routes
- Summary BGP4 route information
- The router's BGP4 route table
- Route flap dampening statistics
- Active route maps (the route map configuration information in the running-config)

Displaying Summary BGP4 Information

You can display the local AS number, the maximum number of routes and neighbors supported, and some BGP4 statistics using either of the following methods.

USING THE CLI

To view summary BGP4 information for the router, enter the following command at any CLI prompt:

```
HP9300# show ip bgp summary
```

Here is an example of the information displayed by this command:

```
HP9300# show ip bgp summary

 BGP4 Summary
  Router ID: 1.2.4.2   Local AS Number : 1
  Confederation Identifier : not configured
  Confederation Peers:
  Maximum Number of Paths Supported for Load Sharing : 2
  Number of Neighbors Configured : 3
  Number of Routes Installed : 65871
  Number of Routes Advertising to All Neighbors : 65871
  Number of Attribute Entries Installed : 7750
  Neighbor Address  AS#   State   Time       RtRecv RtAcpt RtSent RtToSend
  192.168.11.1     64512  ESTAB   0:0:43:54 65871  65871  65871  0
  192.168.88.28    64512  ESTAB   0:2:26:43 1      1      1      0
  192.168.199.1    64513  ESTAB   0:0:48:5  0      0      0      0
```

This display shows the following information.

Table 10.4: BGP4 Summary Information

This Field...	Displays...
Router ID	The routing switch's router ID.
Local AS Number	The BGP4 AS number the router is in.
Confederation Identifier	The AS number of the confederation the routing switch is in.
Confederation Peers	The numbers of the local ASs contained in the confederation. This list matches the confederation peer list you configure on the routing switch.

Table 10.4: BGP4 Summary Information (Continued)

This Field...	Displays...
Maximum Number of Paths Supported for Load Sharing	The maximum number of route paths across which the device can balance traffic to the same destination. The feature is enabled by default but the default number of paths is 1. You can increase the number from 2 – 8 paths. See “BGP4 Load Sharing”.
Number of Neighbors Configured	The number of BGP4 neighbors configured on this routing switch.
Number of Routes Installed	The number of BGP4 routes in the router’s BGP4 route table. To display the BGP4 route table, see “Displaying the BGP4 Route Table” on page 10-102.
Number of Routes Advertising to All Neighbors	The total of the RtSent and RtToSend columns for all neighbors.
Number of Attribute Entries Installed	The number of BGP4 route-attribute entries in the router’s route-attributes table. To display the route-attribute table, see “Displaying BGP4 Route-Attribute Entries” on page 10-109.
Neighbor Address	The IP addresses of this router’s BGP4 neighbors.

Table 10.4: BGP4 Summary Information (Continued)

This Field...	Displays...

State	The state of this router's neighbor session with each neighbor. The states are from this router's perspective of the session, not the neighbor's perspective. The state values are based on the BGP4 state machine values described in RFC 1771 and can be one of the following for each router:
	• IDLE – The BGP4 process is waiting to be started. Usually, enabling BGP4 or establishing a neighbor session starts the BGP4 process.
	    • A minus sign (-) indicates that the session has gone down and the software is clearing or removing routes.
	• ADMND – The neighbor has been administratively shut down. See "Administratively Shutting Down a Session with a BGP4 Neighbor" on page 10-22.
	    • A minus sign (-) indicates that the session has gone down and the software is clearing or removing routes.
	• CONNECT – BGP4 is waiting for the connection process for the TCP neighbor session to be completed.
	• ACTIVE – BGP4 is waiting for a TCP connection from the neighbor.
	Note: If the state frequently changes between CONNECT and ACTIVE, there may be a problem with the TCP connection.
	• OPEN SENT – BGP4 is waiting for an Open message from the neighbor.
	• OPEN CONFIRM – BGP4 has received an OPEN message from the neighbor and is now waiting for either a KEEPALIVE or NOTIFICATION message. If the router receives a KEEPALIVE message from the neighbor, the state changes to Established. If the message is a NOTIFICATION, the state changes to Idle.
	• ESTABLISHED – BGP4 is ready to exchange UPDATE packets with the neighbor.
	    • If there is more BGP data in the TCP receiver queue, a plus sign (+) is also displayed.
	Note: If you display information for the neighbor using the **show ip bgp neighbor** <ip-addr> command, the TCP receiver queue value will be greater than 0.

Time	The time that has passed since the state last changed.
RtRecv	The total number or routes received in UPDATE messages from the neighbor since the session was first established.
RtAcpt	The number of routes received from the neighbor that this router actually installed in the BGP4 route table. Usually, this number is lower than the RoutesRcvd number. The difference indicates that this router filtered out some of the routes received in the UPDATE messages.

Table 10.4: BGP4 Summary Information (Continued)

This Field...	Displays...
RtSent	The number of BGP4 routes that the routing switch has sent to the neighbor.
RtToSend	The number of routes the routing switch has queued to send to this neighbor.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Summary link to display the BGP Neighbor Summary panel.

Displaying the Active BGP4 Configuration

To view the active BGP4 configuration information contained in the running-config without displaying the entire running-config, use the following CLI method.

USING THE CLI

To display the device's active BGP4 configuration, enter the following command at any level of the CLI:

```
HP9300# show ip bgp config
Current BGP configuration:
router bgp
 address-filter  1 deny  any   any
 as-path-filter  1 permit ^65001$
 local-as 65002
 maximum-paths 4
 neighbor pg1 peer-group
 neighbor pg1 remote-as 65001
 neighbor pg1 description "HP9300 group 1"
 neighbor pg1 distribute-list out 1
 neighbor 192.169.100.1 peer-group pg1
 neighbor 192.169.101.1 peer-group pg1
 neighbor 192.169.102.1 peer-group pg1
 neighbor 192.169.201.1 remote-as 65101
 neighbor 192.169.201.1 shutdown
 neighbor 192.169.220.3 remote-as 65432
 network 1.1.1.0 255.255.255.0
 network 2.2.2.0 255.255.255.0
 redistribute connected
```

Syntax: show ip bgp config

USING THE WEB MANAGEMENT INTERFACE

You cannot display the BGP4 running-config information using the Web management interface.

Displaying Summary Neighbor Information

To display information for a neighbor, use the following CLI method.

USING THE CLI

To display summary neighbor information, enter a command such as the following at any level of the CLI:

```
HP9300(config-bgp-router)# show ip bgp neighbor 192.168.4.211 routes-summary

Routes Received:18,  Accepted/Installed:18,  Filtered:0
   Routes Selected as BEST Routes:17
      BEST Routes not Installed in IP Forwarding Table:1
   Unreachable Routes (no IGP Route for NEXTHOP):1
   History Routes:0
NLRIs Received in Update Message:19,  Withdraws:1,  Replacements:0
   NLRIs Discarded due to
      Maximum Prefix Limit:0, AS Loop:0, Invalid Nexthop:0
      Duplicated Originator_ID:0, Cluster_ID:0

Routes Advertised:2,  To be Sent:0,  To be Withdrawn:0
NLRIs Sent in Update Message:2,  Withdraws:0,  Replacements:0

Peer Out of Memory Count for:
   Receiving Update Messages:0, Accepting Routes(NLRI):0
   Attributes:0, Outbound Routes(RIB-out):0
```

This display shows the following information.

Table 10.5: BGP4 Route Summary Information for a Neighbor

This Field...	Displays...
Routes Received	How many routes the routing switch has received from the neighbor during the current BGP4 session. • Accepted/Installed – Indicates how many of the received routes the routing switch accepted and installed in the BGP4 route table. • Filtered – Indicates how many of the received routes the routing switch did not accept or install because they were denied by filters on the routing switch.
Routes Selected as BEST Routes	The number of routes that the routing switch selected as the best routes to their destinations.
BEST Routes not Installed in IP Forwarding Table	The number of routes received from the neighbor that are the best BGP4 routes to their destinations, but were nonetheless not installed in the IP route table because the routing switch received better routes from other sources (such as OSPF, RIP, or static IP routes).
Unreachable Routes	The number of routes received from the neighbor that are unreachable because the routing switch does not have a valid RIP, OSPF, or static route to the next hop.
History Routes	The number of routes that are down but are being retained for route flap dampening purposes.

Table 10.5: BGP4 Route Summary Information for a Neighbor (Continued)

This Field...	Displays...
NLRIs Received in Update Message	The number of routes received in Network Layer Reachability (NLRI) format in UPDATE messages. • Withdraws – The number of withdrawn routes the routing switch has received. • Replacements – The number of replacement routes the routing switch has received.
NLRIs Discarded due to	Indicates the number of times the routing switch discarded an NLRI for the neighbor due to the following reasons: • Maximum Prefix Limit – The routing switch's configured maximum prefix amount had been reached. • AS Loop – An AS loop occurred. An AS loop occurs when the BGP4 AS-path attribute contains the local AS number. • Invalid Nexthop – The next hop value was not acceptable. • Duplicated Originator_ID – The originator ID was the same as the local router ID. • Cluster_ID – The cluster list contained the local cluster ID, or contained the local router ID (see above) if the cluster ID is not configured.
Routes Advertised	The number of routes the routing switch has advertised to this neighbor. • To be Sent – The number of routes the routing switch has queued to send to this neighbor. • To be Withdrawn – The number of NLRIs for withdrawing routes the routing switch has queued up to send to this neighbor in UPDATE messages.
NLRIs Sent in Update Message	The number of NLRIs for new routes the routing switch has sent to this neighbor in UPDATE messages. • Withdraws – The number of routes the routing switch has sent to the neighbor to withdraw. • Replacements – The number of routes the routing switch has sent to the neighbor to replace routes the neighbor already has.

Table 10.5: BGP4 Route Summary Information for a Neighbor (Continued)

This Field...	Displays...
Peer Out of Memory Count for	Statistics for the times the routing switch has run out of BGP4 memory for the neighbor during the current BGP4 session. • Receiving Update Messages – The number of times UPDATE messages were discarded because there was no memory for attribute entries. • Accepting Routes(NLRI) – The number of NLRIs discarded because there was no memory for NLRI entries. This count is not included in the Receiving Update Messages count. • Attributes – The number of times there was no memory for BGP4 attribute entries. • Outbound Routes(RIB-out) – The number of times there was no memory to place a “best” route into the neighbor's route information base (Adj-RIB-Out) for routes to be advertised.

USING THE WEB MANAGEMENT INTERFACE

You cannot display summary neighbor information using the Web management interface.

Displaying BGP4 Neighbor Information

You can display configuration information and statistic for the router’s BGP4 neighbors using either of the following methods.

USING THE CLI

To view BGP4 neighbor information for the router, enter the following command:

```
HP9300# show ip bgp neighbors 192.168.4.211
    IP Address      AS#    EBGP/IBGP   RouterID        PeerGroup
1   192.168.4.211   65001  EBGP        8.8.8.8         None
    State       Time       KeepAlive   HoldTime  RefreshCapability
    ESTABLISHED 0h1m5s     60          180       Received
    SendCommunity NextHopSelf DefaultOriginate ReflectorClient UpdateSource
    No            No          No               No              None
                       Open    Update  KeepAlive Notification Refresh-Req
    Message Sent:      2       6       2         1            1
    Message Received:  2       15      4         0            1
    Last Connection Reset Reason:User Reset Peer Session
    Notification Sent:     Unspecified
    Notification Received: Unspecified
    TCP Connection state: ESTABLISHED
       Local host:  192.168.2.102, Local  Port: 8118
       Remote host: 192.168.4.211, Remote Port: 179
       ISentSeq:    2752793  SendNext:    2753085  TotUnAck:          0
       TotSent:         292  ReTrans:           0  UnAckSeq:    2753085
       IRcvSeq:  4010160420  RcvNext:  4010161139  SendWnd:       16093
       TotalRcv:        719  DupliRcv:          0  RcvWnd:        16384
       SendQue:           0  RcvQue:            0  CngstWnd:       1181
```

This example shows how to display information for a specific neighbor, by specifying the neighbor’s IP address with the command. None of the other display options are used; thus, all of the information is displayed for the neighbor. The number in the far left column indicates the neighbor for which information is displayed. When you list information for multiple neighbors, this number makes the display easier to read.

The TCP statistics at the end of the display show status for the TCP session with the neighbor. Most of the fields show information stored in the routing switch's Transmission Control Block (TCB) for the TCP session between the routing switch and its neighbor. These fields are described in detail in section 3.2 of RFC 793, "Transmission Control Protocol Functional Specification".

In this example, a specific neighbor's IP address is entered. The command therefore shows information only for that neighbor. None of the other options are used; thus, all the information about the neighbor is displayed. The numbers in the leftmost column separate the entries for each neighbor.

Syntax: show ip bgp neighbors [<ip-addr> [advertised-routes [detail [<ip-addr>[/<mask-bits>]]]] | [attribute-entries [detail]] | [flap-statistics] | [last-packet-with-error] |
[received-routes [best] | [detail [best] | [not-installed-best] | [unreachable]] |
[rib-out-routes [<ip-addr>/<mask-bits> | <ip-addr> <net-mask> | detail]] | [routes-summary]]

The <ip-addr> option lets you narrow the scope of the command to a specific neighbor.

The **advertised-routes** option displays only the routes that the routing switch has advertised to the neighbor during the current BGP4 neighbor session.

The **attribute-entries** option shows the attribute-entries associated with routes received from the neighbor.

The **flap-statistics** option shows the route flap statistics for routes received from or sent to the neighbor.

The **last-packet-with-error** displays a hexadecimal dump of the first 400 bytes of the last packet received from the neighbor that contained an error.

The **received-routes** option lists the routes received in UPDATE messages from the neighbor. You can specify the following additional options:

- **best** – Displays the routes received from the neighbor that the routing switch selected as the best routes to their destinations.
- **not-installed-best** – Displays the routes received from the neighbor that are the best BGP4 routes to their destinations, but were nonetheless not installed in the IP route table because the routing switch received better routes from other sources (such as OSPF, RIP, or static IP routes).
- **unreachable** – Displays the routes that are unreachable because the routing switch does not have a valid RIP, OSPF, or static route to the next hop.
- **detail** – Displays detailed information for the specified routes. You can refine your information request by also specifying one of the options above (**best**, **not-installed-best**, or **unreachable**).

The **rib-out-routes** option lists the route information base (RIB) for outbound routes. You can display all the routes or specify a network address.

The **routes-summary** option displays a summary of the following information:

- Number of routes received from the neighbor
- Number of routes accepted by this routing switch from the neighbor
- Number of routes this routing switch filtered out of the UPDATES received from the neighbor and did not accept
- Number of routes advertised to the neighbor
- Number of attribute entries associated with routes received from or advertised to the neighbor.

This display shows the following information.

Table 10.6: BGP4 Neighbor Information

This Field...	Displays...
IP Address	The IP address of the neighbor.
AS#	The AS the neighbor is in.

Table 10.6: BGP4 Neighbor Information (Continued)

This Field...	Displays...
EBGP/IBGP	Whether the neighbor session is an IBGP session, an EBGP session, or a confederation EBGP session. • EBGP – The neighbor is in another AS. • EBGP_Confed – The neighbor is a member of another sub-AS in the same confederation. • IBGP – The neighbor is in the same AS.
RouterID	The neighbor's router ID.
PeerGroup	The name of the peer group the neighbor is in, if applicable.

State	The state of the router's session with the neighbor. The states are from this router's perspective of the session, not the neighbor's perspective. The state values are based on the BGP4 state machine values described in RFC 1771 and can be one of the following for each router:
	• IDLE – The BGP4 process is waiting to be started. Usually, enabling BGP4 or establishing a neighbor session starts the BGP4 process.
	  • A minus sign (-) indicates that the session has gone down and the software is clearing or removing routes.
	• ADMND – The neighbor has been administratively shut down. See "Administratively Shutting Down a Session with a BGP4 Neighbor" on page 10-22.
	  • A minus sign (-) indicates that the session has gone down and the software is clearing or removing routes.
	• CONNECT – BGP4 is waiting for the connection process for the TCP neighbor session to be completed.
	• ACTIVE – BGP4 is waiting for a TCP connection from the neighbor.
	Note: If the state frequently changes between CONNECT and ACTIVE, there may be a problem with the TCP connection.
	• OPEN SENT – BGP4 is waiting for an Open message from the neighbor.
	• OPEN CONFIRM – BGP4 has received an OPEN message from the neighbor and is now waiting for either a KEEPALIVE or NOTIFICATION message. If the router receives a KEEPALIVE message from the neighbor, the state changes to Established. If the message is a NOTIFICATION, the state changes to Idle.
	• ESTABLISHED – BGP4 is ready to exchange UPDATE messages with the neighbor.
	  • If there is more BGP data in the TCP receiver queue, a plus sign (+) is also displayed.
	Note: If you display information for the neighbor using the show ip bgp neighbor <ip-addr> command, the TCP receiver queue value will be greater than 0.

Table 10.6: BGP4 Neighbor Information (Continued)

This Field...	Displays...
Time	The amount of time this session has been in its current state.
KeepAlive	The keep alive time, which specifies how often this router sends keep alive messages to the neighbor. See “Changing the Keep Alive Time and Hold Time” on page 10-23.
HoldTime	The hold time, which specifies how many seconds the router will wait for a KEEPALIVE or UPDATE message from a BGP4 neighbor before deciding that the neighbor is dead. See “Changing the Keep Alive Time and Hold Time” on page 10-23.
RefreshCapability	Whether this routing switch has received confirmation from the neighbor that the neighbor supports the dynamic refresh capability.
SendCommunity	Whether this option is enabled for the neighbor.
NextHopSelf	Whether this option is enabled for the neighbor.
DefaultOriginate	Whether this option is enabled for the neighbor.
ReflectorClient	Whether this option is enabled for the neighbor.
UpdateSource	Whether this option is enabled for the neighbor and the value of the option if enabled.
Message Sent	The number of messages this router has sent to the neighbor. The display shows statistics for the following message types: • Open • Update • KeepAlive • Notification • Refresh-Req
Message Received	The number of messages this router has received from the neighbor. The message types are the same as for the Message Sent field.

Table 10.6: BGP4 Neighbor Information (Continued)

This Field...	Displays...

Last Connection Reset Reason	The reason the previous session with this neighbor ended. The reason can be one of the following:
	• Reasons described in the BGP specifications:
	  • Message Header Error
	  • Connection Not Synchronized
	  • Bad Message Length
	  • Bad Message Type
	  • OPEN Message Error
	  • Unsupported Version Number
	  • Bad Peer AS Number
	  • Bad BGP Identifier
	  • Unsupported Optional Parameter
	  • Authentication Failure
	  • Unacceptable Hold Time
	  • Unsupported Capability
	  • UPDATE Message Error
	  • Malformed Attribute List
	  • Unrecognized Well-known Attribute
	  • Missing Well-known Attribute
	  • Attribute Flags Error
	  • Attribute Length Error
	  • Invalid ORIGIN Attribute
	  • Invalid NEXT_HOP Attribute
	  • Optional Attribute Error
	  • Invalid Network Field
	  • Malformed AS_PATH
	  • Hold Timer Expired
	  • Finite State Machine Error
	  • Rcv Notification

Table 10.6: BGP4 Neighbor Information (Continued)

This Field...	Displays...
Last Connection Reset Reason (cont.)	• Reasons specific to the HP implementation: • Reset All Peer Sessions • User Reset Peer Session • Port State Down • Peer Removed • Peer Shutdown • Peer AS Number Change • Peer AS Confederation Change • TCP Connection KeepAlive Timeout • TCP Connection Closed by Remote • TCP Data Stream Error Detected

Table 10.6: BGP4 Neighbor Information (Continued)

This Field...	Displays...

Notification Sent	If the router receives a NOTIFICATION message from the neighbor, the message contains an error code corresponding to one of the following errors. Some errors have subcodes that clarify the reason for the error. Where applicable, the subcode messages are listed underneath the error code messages.
	• Message Header Error
	    • Connection Not Synchronized
	    • Bad Message Length
	    • Bad Message Type
	    • Unspecified
	• Open Message Error
	    • Unsupported Version
	    • Bad Peer As
	    • Bad BGP Identifier
	    • Unsupported Optional Parameter
	    • Authentication Failure
	    • Unacceptable Hold Time
	    • Unspecified
	• Update Message Error
	    • Malformed Attribute List
	    • Unrecognized Attribute
	    • Missing Attribute
	    • Attribute Flag Error
	    • Attribute Length Error
	    • Invalid Origin Attribute
	    • Invalid NextHop Attribute
	    • Optional Attribute Error
	    • Invalid Network Field
	    • Malformed AS Path
	    • Unspecified
	• Hold Timer Expired
	• Finite State Machine Error
	• Cease
	• Unspecified

Notification Received	See above.

Table 10.6: BGP4 Neighbor Information (Continued)

This Field...	Displays...
TCP Connection state	The state of the connection with the neighbor. The connection can have one of the following states: • LISTEN – Waiting for a connection request. • SYN-SENT – Waiting for a matching connection request after having sent a connection request. • SYN-RECEIVED – Waiting for a confirming connection request acknowledgment after having both received and sent a connection request. • ESTABLISHED – Data can be sent and received over the connection. This is the normal operational state of the connection. • FIN-WAIT-1 – Waiting for a connection termination request from the remote TCP, or an acknowledgment of the connection termination request previously sent. • FIN-WAIT-2 – Waiting for a connection termination request from the remote TCP. • CLOSE-WAIT – Waiting for a connection termination request from the local user. • CLOSING – Waiting for a connection termination request acknowledgment from the remote TCP. • LAST-ACK – Waiting for an acknowledgment of the connection termination request previously sent to the remote TCP (which includes an acknowledgment of its connection termination request). • TIME-WAIT – Waiting for enough time to pass to be sure the remote TCP received the acknowledgment of its connection termination request. • CLOSED – There is no connection state.
Local host	The IP address of the routing switch.
Local port	The TCP port the routing switch is using for the BGP4 TCP session with the neighbor.
Remote host	The IP address of the neighbor.
Remote port	The TCP port the neighbor is using for the BGP4 TCP session with the routing switch.
ISentSeq	The initial send sequence number for the session.
SendNext	The next sequence number to be sent.
TotUnAck	The number of sequence numbers sent by the routing switch that have not been acknowledged by the neighbor.
TotSent	The number of sequence numbers sent to the neighbor.
ReTrans	The number of sequence numbers that the routing switch retransmitted because they were not acknowledged.

Table 10.6: BGP4 Neighbor Information (Continued)

This Field...	Displays...
UnAckSeq	The current acknowledged sequence number.
IRcvSeq	The initial receive sequence number for the session.
RcvNext	The next sequence number expected from the neighbor.
SendWnd	The size of the send window.
TotalRcv	The number of sequence numbers received from the neighbor.
DupliRcv	The number of duplicate sequence numbers received from the neighbor.
RcvWnd	The size of the receive window.
SendQue	The number of sequence numbers in the send queue.
RcvQue	The number of sequence numbers in the receive queue.
CngstWnd	The number of times the window has changed.

Displaying Route Information for a Neighbor

You can display routes based on the following criteria:

- A summary of the routes for a specific neighbor.
- The routes received from the neighbor that the routing switch selected as the best routes to their destinations.
- The routes received from the neighbor that are the best BGP4 routes to their destinations, but were nonetheless not installed in the IP route table because the routing switch received better routes from other sources (such as OSPF, RIP, or static IP routes).
- The routes that are unreachable because the routing switch does not have a valid RIP, OSPF, or static route to the next hop.
- Routes for a specific network advertised by the routing switch to the neighbor.
- The Routing Information Base (RIB) for a specific network advertised to the neighbor. You can display the RIB regardless of whether the routing switch has already sent it to the neighbor.

To display route information for a neighbor, use the following CLI methods.

USING THE CLI

Displaying Summary Route Information

To display summary route information, enter a command such as the following at any level of the CLI:

```
HP9300(config-bgp-router)# show ip bgp neighbor 192.168.4.211 routes-summary

Routes Received:18,  Accepted/Installed:18,  Filtered:0
   Routes Selected as BEST Routes:17
      BEST Routes not Installed in IP Forwarding Table:1
   Unreachable Routes (no IGP Route for NEXTHOP):1
   History Routes:0
NLRIs Received in Update Message:19,  Withdraws:1,  Replacements:0
   NLRIs Discarded due to
      Maximum Prefix Limit:0, AS Loop:0, Invalid Nexthop:0
      Duplicated Originator_ID:0, Cluster_ID:0

Routes Advertised:2,  To be Sent:0,  To be Withdrawn:0
NLRIs Sent in Update Message:2,  Withdraws:0,  Replacements:0
```

```
Peer Out of Memory Count for:
   Receiving Update Messages:0, Accepting Routes(NLRI):0
   Attributes:0, Outbound Routes(RIB-out):0
```

This display shows the following information.

Table 10.7: BGP4 Route Summary Information for a Neighbor

This Field...	Displays...
Routes Received	How many routes the routing switch has received from the neighbor during the current BGP4 session. • Accepted/Installed – Indicates how many of the received routes the routing switch accepted and installed in the BGP4 route table. • Filtered – Indicates how many of the received routes the routing switch did not accept or install because they were denied by filters on the routing switch.
Routes Selected as BEST Routes	The number of routes that the routing switch selected as the best routes to their destinations.
BEST Routes not Installed in IP Forwarding Table	The number of routes received from the neighbor that are the best BGP4 routes to their destinations, but were nonetheless not installed in the IP route table because the routing switch received better routes from other sources (such as OSPF, RIP, or static IP routes).
Unreachable Routes	The number of routes received from the neighbor that are unreachable because the routing switch does not have a valid RIP, OSPF, or static route to the next hop.
History Routes	The number of routes that are down but are being retained for route flap dampening purposes.
NLRIs Received in Update Message	The number of routes received in Network Layer Reachability (NLRI) format in UPDATE messages. • Withdraws – The number of withdrawn routes the routing switch has received. • Replacements – The number of replacement routes the routing switch has received.
NLRIs Discarded due to	Indicates the number of times the routing switch discarded an NLRI for the neighbor due to the following reasons: • Maximum Prefix Limit – The routing switch's configured maximum prefix amount had been reached. • AS Loop – An AS loop occurred. An AS loop occurs when the BGP4 AS-path attribute contains the local AS number. • Invalid Nexthop – The next hop value was not acceptable. • Duplicated Originator_ID – The originator ID was the same as the local router ID. • Cluster_ID – The cluster list contained the local cluster ID, or contained the local router ID (see above) if the cluster ID is not configured.

Table 10.7: BGP4 Route Summary Information for a Neighbor (Continued)

This Field...	Displays...
Routes Advertised	The number of routes the routing switch has advertised to this neighbor. • To be Sent – The number of routes the routing switch has queued to send to this neighbor. • To be Withdrawn – The number of NLRIs for withdrawing routes the routing switch has queued up to send to this neighbor in UPDATE messages.
NLRIs Sent in Update Message	The number of NLRIs for new routes the routing switch has sent to this neighbor in UPDATE messages. • Withdraws – The number of routes the routing switch has sent to the neighbor to withdraw. • Replacements – The number of routes the routing switch has sent to the neighbor to replace routes the neighbor already has.
Peer Out of Memory Count for	Statistics for the times the routing switch has run out of BGP4 memory for the neighbor during the current BGP4 session. • Receiving Update Messages – The number of times UPDATE messages were discarded because there was no memory for attribute entries. • Accepting Routes(NLRI) – The number of NLRIs discarded because there was no memory for NLRI entries. This count is not included in the Receiving Update Messages count. • Attributes – The number of times there was no memory for BGP4 attribute entries. • Outbound Routes(RIB-out) – The number of times there was no memory to place a “best” route into the neighbor's route information base (Adj-RIB-Out) for routes to be advertised.

Displaying Advertised Routes

To display the routes the routing switch has advertised to a specific neighbor for a specific network, enter a command such as the following at any level of the CLI:

```
HP 9304M or HP 9308M# show ip bgp neighbors 192.168.4.211 advertised-routes
       There are 2 routes advertised to neighbor 192.168.4.211
Status A:AGGREGATE B:BEST b:NOT-INSTALLED-BEST I:IBGP L:LOCAL
       Network         ML Next Hop       Metric     LocPrf     Weight     Status
1     102.0.0.0       24 192.168.2.102   12                    32768      BL
2      200.1.1.0       24 192.168.2.102   0                     32768    BL
```

You also can enter a specific route, as in the following example:

```
HP 9304M or HP 9308M# show ip bgp neighbors 192.168.4.211 advertised 200.1.1.0/24
Status A:AGGREGATE B:BEST b:NOT-INSTALLED-BEST I:IBGP L:LOCAL
       Network         ML Next Hop       Metric     LocPrf     Weight     Status
1      200.1.1.0       24 192.168.2.102  0                     32768      BL
```

Syntax: show ip bgp neighbor <ip-addr> advertised-routes [<ip-addr>/<prefix>]

For information about the fields in this display, see Table 10.9 on page 10-105. The fields in this display also appear in the **show ip bgp** display.

Displaying the Best Received Routes

To display the routes received from a specific neighbor that are the "best" routes to their destinations, enter a command such as the following at any level of the CLI:

```
HP9300(config-bgp-router)# show ip bgp neighbor 192.168.4.211 received-routes best
```

Syntax: show ip bgp neighbor <ip-addr> received-routes best

For information about the fields in this display, see Table 10.9 on page 10-105. The fields in this display also appear in the **show ip bgp** display.

Displaying the Best Received Routes that Were Nonetheless Not Installed in the IP Route Table

To display the BGP4 routes received from a specific neighbor that are the "best" routes to their destinations but are not installed in the routing switch's IP route table, enter a command such as the following at any level of the CLI:

```
HP9300(config-bgp-router)# show ip bgp neighbor 192.168.4.211 received-routes not-
installed-best
```

Each of the displayed routes is a valid path to its destination, but the routing switch received another path from a different source (such as OSPF, RIP, or a static route) that has a lower administrative distance. The routing switch always selects the path with the lowest administrative distance to install in the IP route table.

Syntax: show ip bgp neighbor <ip-addr> received-routes not-installed-best

For information about the fields in this display, see Table 10.9 on page 10-105. The fields in this display also appear in the **show ip bgp** display.

Displaying the Received Routes Whose Destinations Are Unreachable

To display BGP4 routes whose destinations are unreachable using any of the BGP4 paths in the BGP4 route table, enter a command such as the following at any level of the CLI:

```
HP9300(config-bgp-router)# show ip bgp neighbor 192.168.4.211 received-routes
unreachable
```

Syntax: show ip bgp neighbor <ip-addr> received-routes unreachable

For information about the fields in this display, see Table 10.9 on page 10-105. The fields in this display also appear in the **show ip bgp** display.

Displaying the Adj-RIB-Out for a Neighbor

To display the routing switch's current BGP4 Routing Information Base (Adj-RIB-Out) for a specific neighbor and a specific destination network, enter a command such as the following at any level of the CLI:

```
HP9300(config-bgp-router)# show ip bgp neighbor 192.168.4.211 rib-out-routes
192.168.1.0/24
Status A:AGGREGATE B:BEST b:NOT-INSTALLED-BEST I:IBGP L:LOCAL
       Network         ML Next Hop        Metric     LocPrf     Weight Status
1      200.1.1.0       24 0.0.0.0         0          101        32768  BL
```

The Adj-RIB-Out contains the routes that the routing switch either has most recently sent to the neighbor or is about to send to the neighbor.

Syntax: show ip bgp neighbor <ip-addr> rib-out-routes [<ip-addr>/<prefix>]

For information about the fields in this display, see Table 10.9 on page 10-105. The fields in this display also appear in the **show ip bgp** display.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Neighbor link to display the BGP Neighbor Statistics panel.

Displaying Summary Route Information

To display summary route information, use the following CLI method.

USING THE CLI

To display summary statistics for all the routes in the routing switch's BGP4 route table, enter a command such as the following at any level of the CLI:

```
HP9300(config-bgp-router)# show ip bgp routes summary
  Total number of BGP routes (NLRIs) Installed     : 20
  Distinct BGP destination networks                : 20
  Routes originated by this router                 : 2
  Routes selected as BEST routes                   : 19
  BEST routes not installed in IP forwarding table : 1
  Unreachable routes (no IGP route for NEXTHOP)    : 1
  IBGP routes selected as best routes              : 0
  EBGP routes selected as best routes              : 17
```

Syntax: show ip bgp routes summary

This display shows the following information.

Table 10.8: BGP4 Summary Route Information

This Field...	Displays...
Total number of BGP routes (NLRIs) Installed	The number of BGP4 routes the routing switch has installed in the BGP4 route table.
Distinct BGP destination networks	The number of destination networks the installed routes represent. The BGP4 route table can have multiple routes to the same network.
Routes originated by this router	The number of routes in the BGP4 route table that this routing switch originated.
Routes selected as BEST routes	The number of routes in the BGP4 route table that this routing switch has selected as the best routes to the destinations.
BEST routes not installed in IP forwarding table	The number of BGP4 routes that are the best BGP4 routes to their destinations but were not installed in the IP route table because the routing switch received better routes from other sources (such as OSPF, RIP, or static IP routes).
Unreachable routes (no IGP route for NEXTHOP)	The number of routes in the BGP4 route table whose destinations are unreachable because the next hop is unreachable.
IBGP routes selected as best routes	The number of "best" routes in the BGP4 route table that are IBGP routes.
EBGP routes selected as best routes	The number of "best" routes in the BGP4 route table that are EBGP routes.

USING THE WEB MANAGEMENT INTERFACE

You cannot display summary route information using the Web management interface.

Displaying the BGP4 Route Table

BGP4 uses filters you define as well as the algorithm described in "How BGP4 Selects a Path for a Route" on page 10-3 to determine the preferred route to a destination. BGP4 sends only the preferred route to the router's IP table. However, if you want to view all the routes BGP4 knows about, you can display the BGP4 table using either of the following methods.

USING THE CLI

To view the BGP4 route table, enter the following command:

To display all the BGP4 routes in the routing switch’s BGP4 route table that are the best routes to their destinations, enter a command such as the following at any level of the CLI:

```
HP9300(config-bgp-router)# show ip bgp routes
Searching for matching routes, use ^C to quit...
Status A:AGGREGATE B:BEST b:NOT-INSTALLED-BEST C:CONFED_EBGP D:DAMPED
       H:HISTORY I:IBGP L:LOCAL M:MULTIPATH S:SUPPRESSED
       Network         ML Next Hop        Metric     LocPrf     Weight Status
1      4.2.42.0        24 192.168.4.211              101        0      B
2      4.2.43.0        24 192.168.4.211              101        0      D
3      7.7.7.0         24 192.168.4.211   0          101        0      b
4      38.38.38.0      24 192.168.4.211   0          101        0      B
13     102.0.0.0       24 200.1.1.10      12         101        32768  BL
```

Syntax: show ip bgp routes [[network] <ip-addr>] | <num> | [as-path-access-list <num>] | [best] [cidr-only] | [community <num> | no-export | no-advertise | internet | local-as] | [community-access-list <num>] | [community <num> | <num>:<num> | local-as | no-export | no-advertise | internet] | [detail <option>] | [filter-list <num, num,...>] | [not-installed-best] | [prefix-list <string>] | [regular-expression <regular-expression>] | [summary] | [unreachable]

The <ip-addr> option displays routes for a specific network. The **network** keyword is optional. You can enter the network address without entering “network” in front of it.

The <num> option specifies the table entry with which you want the display to start. For example, if you want to list entries beginning with table entry 100, specify 100.

The **as-path-access-list** <num> parameter filters the display using the specified AS-path ACL.

The **best** parameter displays the routes received from the neighbor that the routing switch selected as the best routes to their destinations.

The **cidr-only** option lists only the routes whose network masks do not match their class network length.

The **community** option lets you display routes for a specific community. You can specify **local-as**, **no-export**, **no-advertise**, **internet**, or a private community number. You can specify the community number as either two five-digit integer values of up to 1– 65535, separated by a colon (for example, 12345:6789) or a single long integer value.

The **community-access-list** <num> parameter filters the display using the specified community ACL.

The **community-list** option lets you display routes that match a specific community filter.

The **detail** option lets you display more details about the routes. You can refine your request by also specifying one of the other display options after the **detail** keyword.

The **filter-list** option displays routes that match a specific address filter list.

The **not-installed-best** option displays the routes received from the neighbor that are the best BGP4 routes to their destinations, but were nonetheless not installed in the IP route table because the routing switch received better routes from other sources (such as OSPF, RIP, or static IP routes).

The **prefix-list** <string> parameter filters the display using the specified IP prefix list.

The **regular-expression** <regular-expression> option filters the display based on a regular expression. See “Using Regular Expressions” on page 10-49.

The **summary** option displays summary information for the routes.

The **unreachable** option displays the routes that are unreachable because the routing switch does not have a valid RIP, OSPF, or static route to the next hop.

Displaying the Best BGP4 Routes

To display all the BGP4 routes in the routing switch's BGP4 route table that are the best routes to their destinations, enter a command such as the following at any level of the CLI:

```
HP9300(config-bgp-router)# show ip bgp routes best
Searching for matching routes, use ^C to quit...
Status A:AGGREGATE B:BEST b:NOT-INSTALLED-BEST C:CONFED_EBGP D:DAMPED
       H:HISTORY I:IBGP L:LOCAL M:MULTIPATH S:SUPPRESSED
       Network         ML Next Hop        Metric     LocPrf     Weight Status
1      4.2.42.0        24 192.168.4.211              101        0      B
2      4.2.43.0        24 192.168.4.211              101        0      B
3      7.7.7.0         24 192.168.4.211   0          101        0      b
4      38.38.38.0      24 192.168.4.211   0          101        0      B
13     102.0.0.0       24 200.1.1.10      12         101        32768  BL
```

Syntax: show ip bgp routes best

For information about the fields in this display, see Table 10.9 on page 10-105. The fields in this display also appear in the **show ip bgp** display.

Displaying Those Best BGP4 Routes that Are Nonetheless Not in the IP Route Table

When the routing switch has multiple routes to a destination from different sources (such as BGP4, OSPF, RIP, or static routes), the routing switch selects the route with the lowest administrative distance as the best route, and installs that route in the IP route table.

To display the BGP4 routes are the "best" routes to their destinations but are not installed in the routing switch's IP route table, enter a command such as the following at any level of the CLI:

```
HP9300(config-bgp-router)# show ip bgp routes not-installed-best
Searching for matching routes, use ^C to quit...
Status A:AGGREGATE B:BEST b:NOT-INSTALLED-BEST C:CONFED_EBGP D:DAMPED
       H:HISTORY I:IBGP L:LOCAL M:MULTIPATH S:SUPPRESSED
       Network         ML Next Hop        Metric     LocPrf     Weight Status
1      7.7.7.0         24 192.168.4.211   0          101        0      b
```

Each of the displayed routes is a valid path to its destination, but the routing switch received another path from a different source (such as OSPF, RIP, or a static route) that has a lower administrative distance. The routing switch always selects the path with the lowest administrative distance to install in the IP route table.

Notice that the route status in this example is the new status, "b". See Table 10.9 on page 10-105 for a description.

Syntax: show ip bgp routes not-installed-best

For information about the fields in this display, see Table 10.9 on page 10-105. The fields in this display also appear in the **show ip bgp** display.

NOTE: To display the routes that the routing switch has selected as the best routes and installed in the IP route table, display the IP route table using the **show ip route** command.

Displaying BGP4 Routes Whose Destinations Are Unreachable

To display BGP4 routes whose destinations are unreachable using any of the BGP4 paths in the BGP4 route table, enter a command such as the following at any level of the CLI:

```
HP9300(config-bgp-router)# show ip bgp routes unreachable
Searching for matching routes, use ^C to quit...
Status A:AGGREGATE B:BEST b:NOT-INSTALLED-BEST C:CONFED_EBGP D:DAMPED
       H:HISTORY I:IBGP L:LOCAL M:MULTIPATH S:SUPPRESSED
       Network         ML Next Hop        Metric     LocPrf     Weight Status
1      8.8.8.0         24 192.168.5.1     0          101        0
```

Syntax: show ip bgp routes unreachable

For information about the fields in this display, see Table 10.9 on page 10-105. The fields in this display also appear in the **show ip bgp** display.

Displaying Information for a Specific Route

To display information for a specific BGP4 routes, use either of the following methods.

USING THE CLI

To display BGP4 network information by specifying an IP address within the network, enter a command such as the following at any level of the CLI:

```
HP9300(config-bgp-router)# show ip bgp 7.7.7.1
        Number of BGP Routes matching display condition : 1
Status codes: s suppressed, d damped, h history, * valid, > best, i internal
Origin codes: i - IGP, e - EGP, ? - incomplete
    Network            Next Hop        Metric LocPrf Weight Path
*>  7.7.7.0/24         192.168.4.211   0      101    0       65001 i
```

Syntax: show ip bgp [route] <ip-addr>/<prefix> [longer-prefixes] | <ip-addr>

If you use the **route** option, the display for the information is different, as shown in the following example:

```
HP9300(config-bgp-router)# show ip bgp route 7.7.7.1
        Number of BGP Routes matching display condition : 1
Status A:AGGREGATE B:BEST b:NOT-INSTALLED-BEST C:CONFED_EBGP D:DAMPED
       H:HISTORY I:IBGP L:LOCAL M:MULTIPATH S:SUPPRESSED
       Network         ML Next Hop        Metric     LocPrf     Weight Status
1      7.7.7.0         24 192.168.4.211   0          101        0      b
```

These displays show the following information.

Table 10.9: BGP4 Network Information

This Field...	Displays...
Number of BGP Routes matching display condition	The number of routes that matched the display parameters you entered. This is the number of routes displayed by the command.
Status codes	A list of the characters the display uses to indicate the route's status. The status code appears in the left column of the display, to the left of each route. The status codes are described in the command's output. **Note**: This field appears only if you *do not* enter the **route** option.
Network	The network address.
ML	The length of the CIDR network mask for the route. The number displayed in this column is the number of bits in the mask. **Note**: This field appears only if you enter the **route** option.
Next Hop	The next-hop router for reaching the network from the routing switch.
Metric	The value of the route's MED attribute. If the route does not have a metric, this field is blank.
LocPrf	The degree of preference for this route relative to other routes in the local AS. When the BGP4 algorithm compares routes on the basis of local preferences, the route with the higher local preference is chosen. The preference can have a value from 0 – 4294967295.

Table 10.9: BGP4 Network Information (Continued)

This Field...	Displays...
Weight	The value that this router associates with routes from a specific neighbor. For example, if the router receives routes to the same destination from two BGP4 neighbors, the router prefers the route from the neighbor with the larger weight.
Path	The route's AS path. **Note**: This field appears only if you *do not* enter the **route** option.
Origin code	A character the display uses to indicate the route's origin. The origin code appears to the right of the AS path (Path field). The origin codes are described in the command's output. **Note**: This field appears only if you *do not* enter the **route** option.
Status	The route's status, which can be one or more of the following: • A – AGGREGATE. The route is an aggregate route for multiple networks. • B – BEST. BGP4 has determined that this is the optimal route to the destination. **Note**: If the "b" is shown in lowercase, the software was not able to install the route in the IP route table. • b – NOT-INSTALLED-BEST. The routes received from the neighbor are the best BGP4 routes to their destinations, but were nonetheless not installed in the IP route table because the routing switch received better routes from other sources (such as OSPF, RIP, or static IP routes). • C – CONFED_EBGP. The route was learned from a neighbor in the same confederation and AS, but in a different sub-AS within the confederation. • D – DAMPED. This route has been dampened (by the route dampening feature), and is currently unusable. • H – HISTORY. Route dampening is configured for this route, and the route has a history of flapping and is unreachable now. • I – INTERNAL. The route was learned through BGP4. • L – LOCAL. The route originated on this routing switch. • M – MULTIPATH. BGP4 load sharing is enabled and this route was selected as one of the best ones to the destination. The best route among the multiple paths also is marked with "B". **Note**: If the "m" is shown in lowercase, the software was not able to install the route in the IP route table. • S – SUPPRESSED. This route was suppressed during aggregation and thus is not advertised to neighbors. **Note**: This field appears only if you enter the **route** option.

Displaying Route Details

Here is an example of the information displayed when you use the **detail** option. In this example, the information for one route is shown.

```
HP9300# show ip bgp routes detail
Total number of BGP Routes: 516985
Status A:AGGREGATE B:BEST b:NOT-INSTALLED-BEST C:CONFED_EBGP D:DAMPED
       H:HISTORY I:IB GP L:LOCAL M:MULTIPATH S:SUPPRESSED
       Network             Next Hop         Metric     LocPrf     Weight     Origin
1       0.0.0.0/0          192.169.103.1    None       100        0          IGP
       Atomic   AGGREGATION(ID   AS)    Originator       Cluster List
       None     0.0.0.0          0      None             None
       Status   Learned From   Distance RIB_out Communities
       B        192.169.103.1   20      10      Internet
```

remaining entries not shown...

These displays show the following information.

Table 10.10: BGP4 Network Information

This Field...	Displays...
Total number of BGP Routes	The number of BGP4 routes.
Status codes	A list of the characters the display uses to indicate the route's status. The status code is appears in the left column of the display, to the left of each route. The status codes are described in the command's output.
Network	The network address.
Next Hop	The next-hop router for reaching the network from the routing switch.
Metric	The value of the route's MED attribute. If the route does not have a metric, this field is blank.
LocPrf	The degree of preference for this route relative to other routes in the local AS. When the BGP4 algorithm compares routes on the basis of local preferences, the route with the higher local preference is chosen. The preference can have a value from 0 – 4294967295.
Weight	The value that this router associates with routes from a specific neighbor. For example, if the router receives routes to the same destination from two BGP4 neighbors, the router prefers the route from the neighbor with the larger weight.
Origin	The source of the route information. The origin can be one of the following: • EGP – The routes with this set of attributes came to BGP through EGP. • IGP – The routes with this set of attributes came to BGP through IGP. • INCOMPLETE – The routes came from an origin other than one of the above. For example, they may have been redistributed from OSPF or RIP. When BGP4 compares multiple routes to a destination to select the best route, IGP is preferred over EGP and both are preferred over INCOMPLETE.

Table 10.10: BGP4 Network Information (Continued)

This Field...	Displays...
Atomic	Whether network information in this route has been aggregated *and* this aggregation has resulted in information loss. **Note**: Information loss under these circumstances is a normal part of BGP4 and does not indicate an error.
Aggregation ID	The router that originated this aggregator.
Aggregation AS	The AS in which the network information was aggregated. This value applies only to aggregated routes and is otherwise 0.
Originator	The originator of the route in a route reflector environment.
Cluster List	The route-reflector clusters through which this route has passed.
Status	The route’s status, which can be one or more of the following: • A – AGGREGATE. The route is an aggregate route for multiple networks. • B – BEST. BGP4 has determined that this is the optimal route to the destination. **Note**: If the “b” is shown in lowercase, the software was not able to install the route in the IP route table. • b – NOT-INSTALLED-BEST. The routes received from the neighbor are the best BGP4 routes to their destinations, but were nonetheless not installed in the IP route table because the routing switch received better routes from other sources (such as OSPF, RIP, or static IP routes). • C – CONFED_EBGP. The route was learned from a neighbor in the same confederation and AS, but in a different sub-AS within the confederation. • D – DAMPED. This route has been dampened (by the route dampening feature), and is currently unusable. • H – HISTORY. Route dampening is configured for this route, and the route has a history of flapping and is unreachable now. • I – INTERNAL. The route was learned through BGP4. • L – LOCAL. The route originated on this routing switch. • M – MULTIPATH. BGP4 load sharing is enabled and this route was selected as one of the best ones to the destination. The best route among the multiple paths also is marked with “B”. **Note**: If the “m” is shown in lowercase, the software was not able to install the route in the IP route table. • S – SUPPRESSED. This route was suppressed during aggregation and thus is not advertised to neighbors.
Learned From	The IP address of the neighbor from which the routing switch learned the route.
Distance	The administrative distance of the route.

Table 10.10: BGP4 Network Information (Continued)

This Field...	Displays...
RIB_out	The number of neighbors to which the route has been or will be advertised. This is the number of times the route has been selected as the best route and placed in the Adj-RIB-Out (outbound queue) for a BGP4 neighbor.
Communities	The communities the route is in.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Routes link to display the BGP Routes panel.

Displaying BGP4 Route-Attribute Entries

The route-attribute entries table lists the sets of BGP4 attributes stored in the router's memory. Each set of attributes is unique and can be associated with one or more routes. In fact, the router typically has fewer route attribute entries than routes. To display the route-attribute entries table, use one of the following methods.

USING THE CLI

To display the IP route table, enter the following command:

```
HP9300# show ip bgp attribute-entries
```

Syntax: show ip bgp attribute-entries

Here is an example of the information displayed by this command. A zero value indicates that the attribute is not set.

```
HP9300# show ip bgp attribute-entries
        Total number of BGP Attribute Entries: 7753
1       Next Hop  :192.168.11.1       Metric   :0                Origin:IGP
        Originator:0.0.0.0            Cluster List:None
         Aggregator:AS Number :0         Router-ID:0.0.0.0          Atomic:FALSE
        Local Pref:100                Communities:Internet
        AS Path   :(65002) 65001 4355 2548 3561 5400 6669 5548
2       Next Hop  :192.168.11.1       Metric   :0                Origin:IGP
        Originator:0.0.0.0            Cluster List:None
         Aggregator:AS Number :0         Router-ID:0.0.0.0          Atomic:FALSE
        Local Pref:100                Communities:Internet
        AS Path   :(65002) 65001 4355 2548
```

remaining 7751 entries not shown...

This display shows the following information.

Table 10.11: BGP4 Route-Attribute Entries Information

This Field...	Displays...
Total number of BGP Attribute Entries	The number of routes contained in this router's BGP4 route table.

Table 10.11: BGP4 Route-Attribute Entries Information (Continued)

This Field...	Displays...
Next Hop	The IP address of the next hop router for routes that have this set of attributes.
Metric	The cost of the routes that have this set of attributes.
Origin	The source of the route information. The origin can be one of the following: • EGP – The routes with this set of attributes came to BGP through EGP. • IGP – The routes with this set of attributes came to BGP through IGP. • INCOMPLETE – The routes came from an origin other than one of the above. For example, they may have been redistributed from OSPF or RIP. When BGP4 compares multiple routes to a destination to select the best route, IGP is preferred over EGP and both are preferred over INCOMPLETE.
Originator	The originator of the route in a route reflector environment.
Cluster List	The route-reflector clusters through which this set of attributes has passed.
Aggregator	Aggregator information: • `AS Number` shows the AS in which the network information in the attribute set was aggregated. This value applies only to aggregated routes and is otherwise 0. • `Router-ID` shows the router that originated this aggregator.
Atomic	Whether the network information in this set of attributes has been aggregated *and* this aggregation has resulted in information loss. • TRUE – Indicates information loss has occurred • FALSE – Indicates no information loss has occurred **Note**: Information loss under these circumstances is a normal part of BGP4 and does not indicate an error.
Local Pref	The degree of preference for routes that use this set of attributes relative to other routes in the local AS.
Communities	The communities that routes with this set of attributes are in.
AS Path	The ASs through which routes with this set of attributes have passed. The local AS is shown in parentheses.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to BGP in the tree view to expand the list of BGP option links.
4. Click on the Attributes link to display the BGP Attributes Entries panel.

Displaying the Routes BGP4 Has Placed in the IP Route Table

The IP route table indicates the routes it has received from BGP4 by listing "BGP" as the route type. You can view the IP route table using either of the following methods.

USING THE CLI

To display the IP route table, enter the following command:

```
HP9300# show ip route
```

Syntax: show ip route [<ip-addr> | <num> | bgp | ospf | rip]

Here is an example of the information displayed by this command. Notice that most of the routes in this example have type "B", indicating that their source is BGP4.

```
HP9300# show ip route

Total number of IP routes: 50834

B:BGP D:Directly-Connected  O:OSPF  R:RIP  S:Static

      Network Address  NetMask          Gateway          Port      Cost   Type
      3.0.0.0          255.0.0.0        192.168.13.2     1/1       0      B
      4.0.0.0          255.0.0.0        192.168.13.2     1/1       0      B
      9.20.0.0         255.255.128.0    192.168.13.2     1/1       0      B
      10.1.0.0         255.255.0.0      0.0.0.0          1/1       1      D
      10.10.11.0       255.255.255.0    0.0.0.0          2/24      1      D
      12.2.97.0        255.255.255.0    192.168.13.2     1/1       0      B
      12.3.63.0        255.255.255.0    192.168.13.2     1/1       0      B
      12.3.123.0       255.255.255.0    192.168.13.2     1/1       0      B
      12.5.252.0       255.255.254.0    192.168.13.2     1/1       0      B
      12.6.42.0        255.255.254.0    192.168.13.2     1/1       0      B
```

remaining 50824 entries not shown...

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to IP in the tree view to expand the list of IP option links.
4. Click on the Routing Table link to display the IP route table.

Displaying Route Flap Dampening Statistics

To display route flap dampening statistics, use the following CLI method.

USING THE CLI

To display route dampening statistics or all the dampened routes, enter the following command at any level of the CLI:

```
HP9300# show ip bgp flap-statistics

Total number of flapping routes: 414
    Status Code  >:best d:damped h:history *:valid
    Network            From             Flaps Since    Reuse    Path
h>  192.50.206.0/23    166.90.213.77    1     0 :0 :13 0 :0 :0  65001 4355 1 701
h>  203.255.192.0/20   166.90.213.77    1     0 :0 :13 0 :0 :0  65001 4355 1 7018
h>  203.252.165.0/24   166.90.213.77    1     0 :0 :13 0 :0 :0  65001 4355 1 7018
h>  192.50.208.0/23    166.90.213.77    1     0 :0 :13 0 :0 :0  65001 4355 1 701
h>  133.33.0.0/16      166.90.213.77    1     0 :0 :13 0 :0 :0  65001 4355 1 701
*>  204.17.220.0/24    166.90.213.77    1     0 :1 :4  0 :0 :0  65001 4355 701 62
```

Syntax: show ip bgp flap-statistics [regular-expression <regular-expression> | <address> <mask> [longer-prefixes] | neighbor <ip-addr> | filter-list <num>...]

The **regular-expression** <regular-expression> parameter is a regular expression. The regular expressions are the same ones supported for BGP4 AS-path filters. See “Using Regular Expressions” on page 10-49.

The <address> <mask> parameter specifies a particular route. If you also use the optional **longer-prefixes** parameter, then all statistics for routes that match the specified route or have a longer prefix than the specified route are displayed. For example, if you specify **209.157.0.0 longer**, then all routes with the prefix 209.157. or that have a longer prefix (such as 209.157.22.) are displayed.

The **neighbor** <ip-addr> parameter displays route flap dampening statistics only for routes learned from the specified neighbor. You also can display route flap statistics for routes learned from a neighbor by entering the following command: **show ip bgp neighbor** <ip-addr> **flap-statistics**.

The **filter-list** <num> parameter specifies one or more filters. Only the routes that have been dampened and that match the specified filter(s) are displayed.

This display shows the following information.

Table 10.12: Route Flap Dampening Statistics

This Field...	Displays...
Total number of flapping routes	The total number of routes in the routing switch’s BGP4 route table that have changed state and thus have been marked as flapping routes.
Status code	Indicates the dampening status of the route, which can be one of the following: • > – This is the best route among those in the BGP4 route table to the route’s destination. • d – This route is currently dampened, and thus unusable. • h – The route has a history of flapping and is unreachable now. • * – The route has a history of flapping but is currently usable.
Network	The destination network of the route.
From	The neighbor that sent the route to the routing switch.
Flaps	The number of flaps (state changes) the route has experienced.
Since	The amount of time since the first flap of this route.
Reuse	The amount of time remaining until this route will be un-suppressed and thus be usable again.
Path	Shows the AS-path information for the route.

You also can display all the dampened routes by entering the following command: **show ip bgp dampened-paths**.

USING THE WEB MANAGEMENT INTERFACE

You cannot display dampening statistics using the Web management interface.

Displaying the Active Route Map Configuration

To view the device’s active route map configuration (contained in the running-config) without displaying the entire running-config, use the following CLI method.

USING THE CLI

To display the device’s active route map configuration, enter the following command at any level of the CLI:

```
HP9300# show route-map
route-map permitnet4 permit 10
 match ip address prefix-list plist1
route-map permitnet1 permit 1
 match ip address prefix-list plist2
route-map setcomm permit 1
 set community 1234:2345 no-export
route-map test111 permit 111
 match address-filters 11
 set community 11:12 no-export
route-map permit1122 permit 12
 match ip address 11
route-map permit1122 permit 13
 match ip address std_22
```

This example shows that the running-config contains six route maps. Notice that the match and set statements within each route map are listed beneath the command for the route map itself. In this simplified example, each route map contains only one match or set statement.

To display the active configuration for a specific route map, enter a command such as the following, which specifies a route map name:

```
HP9300# show route-map setcomm
route-map setcomm permit 1
 set community 1234:2345 no-export
```

This example shows the active configuration for a route map called “setcomm“.

Syntax: show route-map [<map-name>]

USING THE WEB MANAGEMENT INTERFACE

You cannot display the active route map configuration using the Web management interface.

Clearing Traffic Counters

You can clear the counters (reset them to 0) for BGP4 messages. To do so, use one of the following methods.

USING THE CLI

To clear the BGP4 message counter for all neighbors, enter the following command:

```
HP9300# clear ip bgp traffic
```

Syntax: clear ip bgp traffic

To clear the BGP4 message counter for a specific neighbor, enter a command such as the following:

```
HP9300# clear ip bgp neighbor 10.0.0.1 traffic
```

To clear the BGP4 message counter for all neighbors within a peer group, enter a command such as the following:

```
HP9300# clear ip bgp neighbor PeerGroup1 traffic
```

Syntax: clear ip bgp neighbor all | <ip-addr> | <peer-group-name> | <as-num> traffic

The **all** | <ip-addr> | <peer-group-name> | <as-num> specifies the neighbor. The <ip-addr> parameter specifies a neighbor by its IP interface with the routing switch. The <peer-group-name> specifies all neighbors in a specific

peer group. The <as-num> parameter specifies all neighbors within the specified AS. The **all** parameter specifies all neighbors.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Command in the tree view to expand the list of command options.
3. Click on the Clear link to display the Clear panel.
4. Select one of the following options:
   - BGP Neighbor Traffic – clears the BGP4 message counters for all neighbors (the default) or a neighbor you select from the pulldown menu.
   - BGP Neighbor – clears the BGP4 message counters for all neighbors (the default) or a neighbor you select from the pulldown menu.
5. Click the Apply button to implement the change.

Clearing Route Flap Dampening Statistics

To clear route flap dampening statistics, use the following CLI method.

NOTE: Clearing the dampening statistics for a route does not change the dampening status of the route.

USING THE CLI

To clear all the route dampening statistics, enter the following command at any level of the CLI:

```
HP9300# clear ip bgp flap-statistics
```

Syntax: clear ip bgp flap-statistics [regular-expression <regular-expression> | <address> <mask> | neighbor <ip-addr>]

The parameters are the same as those for the **show ip bgp flap-statistics** command (except the **longer-prefixes** option is not supported). See “Displaying Route Flap Dampening Statistics” on page 10-79.

NOTE: The **clear ip bgp damping** command not only clears statistics but also un-suppresses the routes. See “Displaying Route Flap Dampening Statistics” on page 10-79.

USING THE WEB MANAGEMENT INTERFACE

You cannot clear dampening statistics using the Web management interface.

Updating Route Information and Resetting a Neighbor Session

The following sections describe ways to update route information with a neighbor, reset the session with a neighbor, and close a session with a neighbor.

You can use the dynamic refresh feature or reset a neighbor session to place route filter updates into effect. See each section for details.

Dynamically Requesting a Route Refresh from a BGP4 Neighbor

You can easily apply changes to filters that control BGP4 routes received from or advertised to a neighbor, without resetting the BGP4 session between the routing switch and the neighbor. For example, if you add, change, or remove a BGP4 address filter that denies specific routes received from a neighbor, you can apply the filter change by requesting a route refresh from the neighbor. If the neighbor also supports dynamic route refreshes, the neighbor resends its Adj-RIB-Out, its table of BGP4 routes. Using the route refresh feature, you do not need to reset the session with the neighbor.

The route refresh feature is based on the following specifications:

- RFC 2842. This RFC specifies the Capability Advertisement, which a BGP4 router uses to dynamically negotiate a capability with a neighbor.
- RFC 2858 for Multi-protocol Extension.

NOTE: The HP implementation of dynamic route refresh supports negotiation of IP version 4 unicasts only.

- bgp-draft-route-refresh-1.txt, which describes the dynamic route refresh capability

The dynamic route refresh capability is enabled by default when you upgrade to software release 07.1.*X* and cannot be disabled. When the routing switch sends a BGP4 OPEN message to a neighbor, the routing switch includes a Capability Advertisement to inform the neighbor that the routing switch supports dynamic route refresh.

NOTE: The option for dynamically refreshing routes received from a neighbor requires the neighbor to support dynamic route refresh. If the neighbor does not support this feature, the option does not take effect and the software displays an error message. The option for dynamically re-advertising routes to a neighbor does not require the neighbor to support dynamic route refresh.

To use the dynamic refresh feature, use either of the following methods.

Dynamically Refreshing Routes

The following sections describe how to dynamically refresh BGP4 routes to place new or changed filters into effect.

USING THE CLI

To request a dynamic refresh of all routes from a neighbor, enter a command such as the following:

```
HP9300(config-bgp-router)# clear ip bgp neighbor 192.168.1.170 soft in
```

This command asks the neighbor to send its BGP4 table (Adj-RIB-Out) again. The routing switch applies its filters to the incoming routes and adds, modifies, or removes BGP4 routes as necessary.

Syntax: clear ip bgp neighbor all | <ip-addr> | <peer-group-name> | <as-num> [soft-outbound | soft [in | out]]

The **all** | <ip-addr> | <peer-group-name> | <as-num> specifies the neighbor. The <ip-addr> parameter specifies a neighbor by its IP interface with the routing switch. The <peer-group-name> specifies all neighbors in a specific peer group. The <as-num> parameter specifies all neighbors within the specified AS. The **all** parameter specifies all neighbors.

The **soft-outbound** parameter updates all outbound routes by applying the new or changed filters, but sends only the existing routes affected by the new or changed filters to the neighbor.

The **soft [in | out]** parameter specifies whether you want to refresh the routes received from the neighbor or sent to the neighbor:

- **soft in** requests the neighbor's entire BGP4 route table (Adj-RIB-Out), then applies the filters to add, change, or exclude routes.
- **soft out** updates all outbound routes, then sends the routing switch's entire BGP4 route table (Adj-RIB-Out) to the neighbor, after changing or excluding the routes affected by the filters.

If you do not specify **in** or **out**, the routing switch performs both options.

NOTE: The **soft-outbound** parameter updates all outbound routes by applying the new or changed filters, but sends only the existing routes affected by the new or changed filters to the neighbor. The **soft out** parameter updates all outbound routes, then sends the routing switch's entire BGP4 route table (Adj-RIB-Out) to the neighbor, after changing or excluding the routes affected by the filters. Use **soft-outbound** if only the outbound policy is changed.

To dynamically resend all the routing switch's BGP4 routes to a neighbor, enter a command such as the following:

```
HP9300(config-bgp-router)# clear ip bgp neighbor 192.168.1.170 soft out
```

This command applies its filters for outgoing routes to the routing switch's BGP4 route table (Adj-RIB-Out), changes or excludes routes accordingly, then sends the resulting Adj-RIB-Out to the neighbor.

NOTE: The HP routing switch does not automatically update outbound routes using a new or changed outbound policy or filter when a session with the neighbor goes up or down. Instead, the routing switch applies a new or changed policy or filter when a route is placed in the outbound queue (Adj-RIB-Out).

To place a new or changed outbound policy or filter into effect, you must enter a **clear ip bgp neighbor** command regardless of whether the neighbor session is up or down. You can enter the command without optional parameters or with the **soft out** or **soft-outbound** option. Either way, you must specify a parameter for the neighbor (<ip-addr>, <as-num>, <peer-group-name>, or **all**).

USING THE WEB MANAGEMENT INTERFACE

You cannot perform these reset procedures using the Web management interface.

Displaying Dynamic Refresh Information

The **show ip bgp neighbors** display is enhanced to show information for dynamic refresh requests. For each neighbor, the display lists the number of dynamic refresh requests the routing switch has sent to or received from the neighbor and indicates whether the routing switch received confirmation from the neighbor that the neighbor supports dynamic route refresh.

In this example, the dynamic refresh statistics are shown in bold type. Notice that the layout of the display has been changed slightly to allow room for this new information. The RefreshCapability field indicates whether this routing switch has received confirmation from the neighbor that the neighbor supports the dynamic refresh capability. The statistics in the Message Sent and Message Received rows under Refresh-Req indicate how many dynamic refreshes have been sent to and received from the neighbor. The statistic is cumulative across sessions.

```
HP9300# show ip bgp neighbors 192.168.4.211
    IP Address      AS#    EBGP/IBGP   RouterID        PeerGroup
1   192.168.4.211   65001  EBGP        8.8.8.8         None
    State       Time       KeepAlive   HoldTime  RefreshCapability
    ESTABLISHED 0h1m5s     60          180       Received
    SendCommunity NextHopSelf DefaultOriginate ReflectorClient UpdateSource
    No            No          No               No              None
                       Open    Update  KeepAlive Notification Refresh-Req
    Message Sent:      2       6       2         1            1
    Message Received:  2       15      4         0            1
    Last Connection Reset Reason:User Reset Peer Session
    Notification Sent:     Unspecified
    Notification Received: Unspecified
    TCP Connection state: ESTABLISHED
       Local host:  192.168.2.102, Local  Port: 8118
       Remote host: 192.168.4.211, Remote Port: 179
       ISentSeq:    2752793  SendNext:    2753085  TotUnAck:          0
       TotSent:         292  ReTrans:           0  UnAckSeq:    2753085
       IRcvSeq:  4010160420  RcvNext:  4010161139  SendWnd:       16093
       TotalRcv:        719  DupliRcv:          0  RcvWnd:        16384
       SendQue:           0  RcvQue:            0  CngstWnd:       1181
```

Closing or Resetting a Neighbor Session

You can close a neighbor session or resend route updates to a neighbor.

If you make changes to filters or route maps and the neighbor does not support dynamic route refresh, use these methods to ensure that neighbors contain only the routes you want them to contain.

- If you close a neighbor session, the routing switch and the neighbor clear all the routes they learned from each other. When the routing switch and neighbor establish a new BGP4 session, they exchange route tables again. Use this method if you want the routing switch to relearn routes from the neighbor and resend its own route table to the neighbor.
- If you use the soft-outbound option, the routing switch compiles a list of all the routes it would normally send to the neighbor at the beginning of a session. However, before sending the updates, the HP routing switch also applies the filters and route maps you have configured to the list of routes. If the filters or route maps result in changes to the list of routes, the routing switch sends updates to advertise, change, or even withdraw routes on the neighbor as needed. This ensures that the neighbor receives only the routes you want it to contain. Even if the neighbor already contains a route learned from the routing switch that you later decided to filter out, using the soft-outbound option removes that route from the neighbor.

You can specify a single neighbor or a peer group.

USING THE CLI

To close a neighbor session and thus flush all the routes exchanged by the routing switch and the neighbor, enter the following command:

```
HP9300# clear ip bgp neighbor all
```

Syntax: clear ip bgp neighbor all | <ip-addr> | <peer-group-name> | <as-num> [soft-outbound | soft [in | out]]

The **all** | <ip-addr> | <peer-group-name> | <as-num> specifies the neighbor. The <ip-addr> parameter specifies a neighbor by its IP interface with the routing switch. The <peer-group-name> specifies all neighbors in a specific peer group. The <as-num> parameter specifies all neighbors within the specified AS. The **all** parameter specifies all neighbors.

To resend routes to a neighbor without closing the neighbor session, enter a command such as the following:

```
HP9300# clear ip bgp neighbor 10.0.0.1 soft out
```

USING THE WEB MANAGEMENT INTERFACE

To resend route information to a neighbor, use the following procedure:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Command in the tree view to expand the list of command options.
3. Click on the Clear link to display the Clear panel.
4. Select BGP Neighbor Soft-Outbound.
5. Use the default value All to resend the BGP4 route table to all neighbors or select a neighbor from the field’s pulldown menu.
6. Click the Apply button to implement the change.

Removing Route Flap Dampening

You can un-suppress routes by removing route flap dampening from the routes. The routing switch allows you to un-suppress all routes at once or un-suppress individual routes.

To un-suppress routes, use either of the following methods.

USING THE CLI

To un-suppress all the suppressed routes, enter the following command at the Privileged EXEC level of the CLI:

```
HP9300# clear ip bgp damping
```

Syntax: clear ip bgp damping [<ip-addr> <ip-mask>]

The <ip-addr> parameter specifies a particular network.

The <ip-mask> parameter specifies the network’s mask.

To un-suppress a specific route, enter a command such as the following:

```
HP9300# clear ip bgp damping 209.157.22.0 255.255.255.0
```

This command un-suppresses only the route(s) for network 209.157.22.0/24.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Command in the tree view to expand the list of command options.
3. Click on the Clear link to display the Clear panel.
4. Select the checkbox next to BGP Dampening.
5. Specify the routes from which you want to remove dampening:
   - To clear dampening for all routes, select the All option.
   - To clear dampening for a specific route, select IP, then enter the network address and sub-net mask in the IP and Mask fields.
6. Click the Apply button to implement the change.

Clearing Diagnostic Buffers

The routing switch stores the following BGP4 diagnostic information in buffers:

- The first 400 bytes of the last packet that contained an error
- The last NOTIFICATION message either sent or received by the routing switch

To display these buffers, use options with the **show ip bgp neighbors** command. See “Displaying BGP4 Neighbor Information” on page 10-90.

This information can be useful if you are working with HP Technical Support to resolve a problem. The buffers do not identify the system time when the data was written to the buffer. If you want to ensure that diagnostic data in a buffer is recent, you can clear the buffers. You can clear the buffers for a specific neighbor or for all neighbors.

If you clear the buffer containing the first 400 bytes of the last packet that contained errors, all the bytes are changed to zeros. The Last Connection Reset Reason field of the BGP neighbor table also is cleared.

If you clear the buffer containing the last NOTIFICATION message sent or received, the buffer contains no data.

You can clear the buffers for all neighbors, for an individual neighbor, or for all the neighbors within a specific peer group.

USING THE CLI

To clear these buffers for neighbor 10.0.0.1, enter the following commands:

```
HP9300# clear ip bgp neighbor 10.0.0.1 last-packet-with-error
HP9300# clear ip bgp neighbor 10.0.0.1 notification-errors
```

Syntax: clear ip bgp neighbor all | <ip-addr> | <peer-group-name> | <as-num>
last-packet-with-error | notification-errors

The **all** | <ip-addr> | <peer-group-name> | <as-num> specifies the neighbor. The <ip-addr> parameter specifies a neighbor by its IP interface with the routing switch. The <peer-group-name> specifies all neighbors in a specific peer group. The <as-num> parameter specifies all neighbors within the specified AS. The **all** parameter specifies all neighbors.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Command in the tree view to expand the list of command options.

3. Click on the Clear link to display the Clear panel.
4. Select one of the following:
    - BGP Neighbor Last Packet with Error – Clears the buffer containing the first 400 bytes of the last BGP4 packet that contained an error.
    - BGP Neighbor Notification Error – Clears the buffer containing the last NOTIFICATION message sent or received.
5. Click the Apply button to implement the change.

Chapter 11
Network Address Translation

You can configure an HP routing switch to perform standard ***Network Address Translation (NAT)***. NAT enables private IP networks that use nonregistered IP addresses to connect to the Internet. Configure NAT on the HP device at the border of an inside network and an outside network (such as the Internet). NAT translates the internal local addresses to globally unique IP addresses before sending packets to the outside network. NAT also allows a more graceful renumbering strategy for organizations that are changing service providers or voluntarily renumbering into Classless Interdomain Routing (CIDR) blocks.

Use NAT to translate your private (inside) IP addresses into globally unique (outside) IP addresses when communicating outside of your network.

NOTE: This feature is supported on all chassis routing switches with Redundant Management modules. It is not available on HP fixed-port devices.

NOTE: The maximum number of global IP addresses you can configure depends on how much memory the routing switch has and whether you enable the Port Address Translation feature. Regardless of the amount of memory, you cannot configure more than 256 global IP addresses.

NOTE: NAT support is available for traffic originated by hosts on the private network. You cannot configure NAT to translate global addresses into private addresses for traffic generated by global addresses.

An HP device configured for NAT must have an interface to the private network and an interface to a public network (for example, the Internet). In a typical environment, NAT is configured on the HP device between the private network and the Internet. When you configure an HP device for NAT, the device does not advertise the private networks to the Internet. However, the device can advertise route information received from the Internet to the private networks.

Figure 11.1 shows a basic example of a network using NAT on an HP device. In this example, an HP 9308M routing switch is using NAT to translate traffic originated from the hosts on the 10.10.10.x/24 sub-net into public addresses from the address pool.

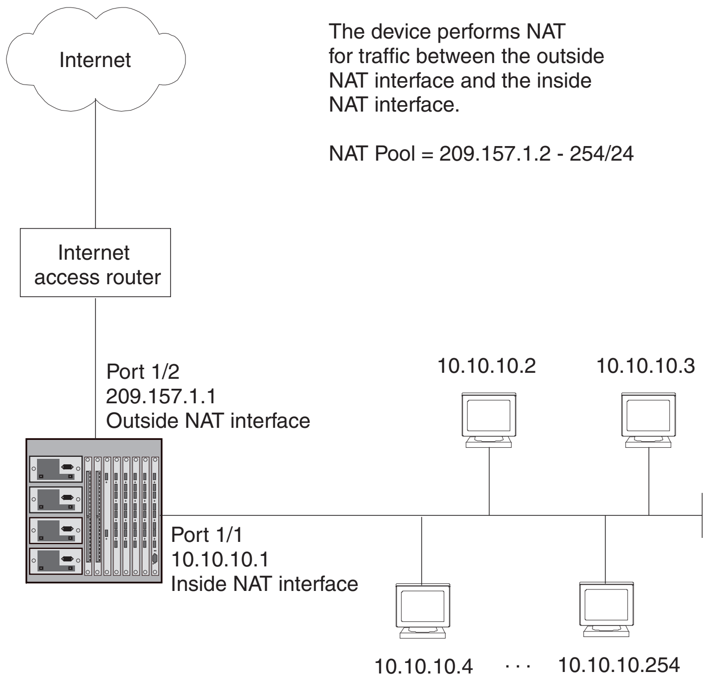


Figure 11.1 Network Using Inside NAT

In this example, the HP 9308M is configured to perform dynamic NAT to translate between the private addresses in the 10.10.10.x/24 sub-net and the Internet addresses in the 209.157.1.x/24 sub-net.

NOTE: This example is simplified to show how NAT is used. For detailed configuration examples, see “Configuration Examples” on page 11-14.

To configure NAT on a routing switch, you must configure an inside NAT interface and an outside NAT interface.

- The inside NAT interface is connected to the private addresses.
- The outside NAT interface is connected to the Internet.

The inside NAT interface in Figure 11.1 uses the address pool 209.157.1.2/24 – 209.157.1.254/24 to map the private addresses to public addresses for traffic initiated by hosts in the 10.10.10.x/24 sub-net.

You can configure the following types of NAT:

- Dynamic NAT – Dynamic NAT maps private addresses to Internet addresses in a pool. The global addresses come from a pool of addresses that you configure. In the example in Figure 11.1, the pool is the range of addresses from 209.157.1.2/24 – 209.157.1.254/24. When you use dynamic NAT, the software uses a round robin technique to select a global IP address to map to a private address from a pool that you configure.
- Static NAT – Static NAT maps a particular global IP address with a particular private address. Use static NAT when you want to ensure that the software always maps the same global address to a given private address. For example, use static NAT when you want specific hosts in the private network to always use the same Internet address when communicating outside the private network.

NOTE: You can configure both dynamic and static NAT on the same HP device. When you configure both types of NAT, static NAT takes precedence over dynamic NAT. Thus, if you configure a static NAT translation for a private address, the device always uses that translation instead of creating a dynamic one.

Port Address Translation

Normally, NAT maps each private address that needs to be routed to the outside network to a unique IP address from the pool. However, it is possible for the global address pool to have fewer addresses than the number of private addresses. In this case, you can configure the HP device to use Port Address Translation. ***Port Address Translation*** maps a client's IP address and TCP or UDP port number to both an IP address and a TCP or UDP port number. In this way, the HP device can map many private addresses to the same public address and use TCP or UDP port numbers to uniquely identify the private hosts.

NOTE: This type of feature is sometimes called Overloading an Inside Global Address.

In the example in Figure 11.1, the pool contains enough addresses to ensure that every host on the private network can be mapped to an Internet address in the pool. However, suppose the enterprise implementing this configuration has only 20 Internet addresses. For example, the pool might be 209.157.1.1/24 – 209.157.1.20/24. In this case, the pool does not contain enough addresses to ensure that all the hosts in the private network can be mapped to Internet addresses.

Without Port Address Translation, it is possible that the device will not be able to provide NAT for some hosts. However, with Port Address Translation, the device can provide NAT for all the hosts by using a unique TCP or UDP port number in addition to the IP address to map to each host. For example, the device can map the following addresses:

Inside address	Outside address
10.10.10.2:6000	209.157.1.2:4000
10.10.10.3:6000	209.157.1.2:4001
10.10.10.4:6000	209.157.1.2:4002

NAT is mapping the same global IP address to three different private addresses along with their TCP or UDP ports, but uses a different TCP or UDP port number for each private address to distinguish them. Notice that the Port Address Translation feature does not attempt to use the same TCP or UDP port number as in the client's packet.

The way NAT deals with the client's TCP or UDP port number depends on whether Port Address Translation is enabled:

- Port Address Translation enabled – NAT treats the client's IP address and TCP or UDP port number as a single entity, and uniquely maps that entity to another entity consisting of an IP address and TCP or UDP port number. The NAT entry the device creates in the NAT translation table therefore consists of an IP address plus a TCP or UDP port number. The device maintains the port type in the translation address:
  - If the client's packet contains a TCP port number, the device uses a TCP port in the translation address.
  - If the client's packet contains a UDP port, the device uses a UDP port in the translation address.

  The device does not try to use the same TCP or UDP port number for the untranslated and translated addresses. Instead, the device maps the client IP address plus the TCP or UDP port number to a unique combination of IP address plus TCP or UDP port number. When the device receives reply traffic to one of these hosts, NAT can properly translate the Internet address back into the private address because the TCP or UDP port number in the translation address uniquely identifies the host.

  To enable Port Address Translation, use the overload option when you configure the source list, which associates a private address range with a pool of Internet addresses. See “Configuring Dynamic NAT Parameters” on page 11-5.
- Port Address Translation disabled – The device translates only the client's IP address into another IP address and retains the TCP or UDP port number unchanged.

Maximum Number of Addresses

If the routing switch cannot allocate an address because it has run out of addresses, the routing switch drops the packet and sends an ICMP Host Unreachable packet.

NOTE: The maximum number of global IP addresses you can configure depends on how much memory the routing switch has and whether you enable the Port Address Translation feature. Regardless of the amount of memory, you cannot configure more than 256 global IP addresses.

Protocols Supported for NAT

HP NAT supports the following protocols:

- ICMP
- UDP/TCP (generic)
- FTP
- VDOLive
- StreamWorks
- CU-SeeMe
- RealAudio and RealVideo
- RealMedia
- QuickTime
- Microsoft Media Services
- Web Theater (Vxtreme)

Configuring NAT

To configure NAT, perform the following tasks:

- Configure the static address mappings, if needed. Static mappings explicitly map a specific private address to a specific Internet address to ensure that the addresses are always mapped together. Use static address mappings when you want to ensure that a specific host in the private network is always mapped to the Internet address you specify.
- Configure dynamic NAT parameters:
  - Configure a standard or extended ACL for each range of private addresses for which you want to provide NAT.
  - Configure a pool for each consecutive range of Internet addresses to which you want NAT to be able to map the private addresses specified in the ACLs. Each pool must contain a range with no gaps. If your Internet address space has gaps, configure separate pools for each consecutive range within the address space.
  - Associate a range of private addresses (specified in a standard or extended ACL) with a pool.
  - Optionally, enable the Port Address Translation feature. Use this feature if you have more private addresses that might need NAT than the Internet address pools contain.
- Enable inside NAT on the interface connected to the private addresses.
- Enable outside NAT on the interface connected to global addresses.

The configuration does not take effect until you enable inside and outside NAT on specific interfaces.

NOTE: You must configure inside NAT on one interface and outside NAT on another interface. The device performs NAT for traffic between the interfaces.

In addition to the tasks listed above, you can modify the age timers for the address translation entries the device creates. See "Changing Translation Table Timeouts" on page 11-7 for information. For information about viewing the active NAT translations, see "Displaying the Active NAT Translations" on page 11-8.

The following sections provide procedures for configuring NAT.

Configuring Static Address Translations

Use the following CLI method to configure static NAT.

NOTE: NAT supports translation of private (inside) addresses into global (outside) addresses only. Translation of global addresses into private addresses is not supported.

USING THE CLI

To configure static NAT for an IP address, enter commands such as the following:

```
HP9300(config)# ip nat inside source static 10.10.10.69 209.157.1.69
```

The commands in this example statically map the private address 10.10.10.69 to the Internet address 209.157.1.69.

Syntax: [no] ip nat inside source static <private-ip> <global-ip>

This command associates a specific private address with a specific Internet address. Use this command when you want to ensure that the specified addresses are always mapped together.

The **inside source** parameter specifies that the mapping applies to the private address sending traffic to the Internet.

The <private-ip> parameter specifies the private IP address.

The <global-ip> parameter specifies the Internet address. The device supports up to 256 global IP addresses.

Neither of the IP address parameters needs a network mask.

Configuring Dynamic NAT Parameters

To configure dynamic NAT:

- Configure a standard or extended ACL for each private address range.
- Configure a pool for each consecutive range of Internet addresses.
- Associate private addresses (ACLs) with pools.
- Optionally, enable the Port Address Translation feature.

Use the following CLI method to configure dynamic NAT.

USING THE CLI

You can configure dynamic NAT with the Port Address Translation feature disabled or enabled.

Example with Port Address Translation Disabled

To configure dynamic NAT with the Port Address Translation feature disabled, enter commands such as the following at the global CONFIG level of the CLI:

```
HP9300(config)# access-list 1 permit 10.10.10.0/24
HP9300(config)# ip nat pool OutAdds 209.157.1.2 209.157.1.254 prefix-length 24
HP9300(config)# ip nat inside source list 1 pool OutAdds
```

These commands configure a standard ACL for the private sub-net 10.10.10.x/24, then enable inside NAT for the sub-net. Make sure you specify **permit** in the ACL, rather than **deny**. If you specify **deny**, the HP device will not provide NAT for the addresses.

Example with Port Address Translation Enabled

To configure dynamic NAT with the Port Address Translation feature enabled, enter commands such as the following at the global CONFIG level of the CLI:

```
HP9300(config)# access-list 1 permit 10.10.10.0/24
HP9300(config)# ip nat pool OutAdds 209.157.1.2 209.157.1.254 prefix-length 24
HP9300(config)# ip nat inside source list 1 pool OutAdds overload
```

These commands are the same as the ones in “Example with Port Address Translation Disabled”, except the **ip nat inside source** command uses the **overload** parameter. This parameter enables the Port Address Translation feature.

Command Syntax

Syntax: [no] ip nat pool <pool-name> <start-ip> <end-ip> netmask <ip-mask> | prefix-length <length>

This command configures the address pool.

The <pool-name> parameter specifies the pool name. The name can be up to 255 characters long and can contain special characters and internal blanks. If you use internal blanks, you must use quotation marks around the entire name.

The <start-ip> parameter specifies the IP address at the beginning of the pool range. Specify the lowest-numbered IP address in the range.

The <end-ip> parameter specifies the IP address at the end of the pool range. Specify the highest-numbered IP address in the range.

NOTE: The address range cannot contain any gaps. Make sure you own all the IP addresses in the range. If the range contains gaps, you must create separate pools containing only the addresses you own.

The **netmask** <ip-mask> | **prefix-length** <length> parameter specifies a classical sub-net mask (example: **netmask** 255.255.255.0) or the length of a Classless Interdomain Routing prefix (example: **prefix-length 24**).

NOTE: The maximum number of global IP addresses you can configure depends on how much memory the routing switch has and whether you enable the Port Address Translation feature. Regardless of the amount of memory, you cannot configure more than 256 global IP addresses.

Syntax: [no] ip nat inside source list <acl-name-or-num> pool <pool-name> [overload]

This command associates a private address range with a pool of Internet addresses and optionally enables the Port Address Translation feature.

The **inside source** parameter specifies that the translation applies to private addresses sending traffic to global addresses (Internet addresses).

The **list** <acl-name-or-num> parameter specifies a standard or extended ACL. You can specify a numbered or named ACL.

NOTE: For complete standard and extended ACL syntax, see “Using Access Control Lists (ACLs)” on page 3-1.

The **pool** <pool-name> parameter specifies the pool. You must create the pool before you can use it with this command.

The **overload** parameter enables the Port Address Translation feature. Use this parameter if the IP address pool does not contain enough addresses to ensure NAT for each private address. The Port Address Translation feature conserves Internet addresses by mapping the same Internet address to more than one private address and using a TCP or UDP port number to distinguish among the private hosts. The device supports up to 50 global IP addresses with this feature enabled.

Enabling NAT

The NAT configuration does not take effect until you enable it on specific interfaces. You can enable NAT on Ethernet ports and on virtual interfaces. You also can enable the feature on the primary port of a trunk group, in which case the feature applies to all the ports in the trunk group.

NOTE: You must configure inside NAT on one interface and outside NAT on another interface. The device performs NAT for traffic between the interfaces.

To enable NAT, use the following CLI methods.

Enabling Inside NAT

To enable inside NAT on the interface attached to the private addresses, use the following CLI method.

USING THE CLI

To enable inside NAT on an interface, enter commands such as the following:

```
HP9300(config)# interface ethernet 1/1
HP9300(config-if-1/1)# ip nat inside
```

This command enables inside NAT on Ethernet port 1/1.

Syntax: [no] ip nat inside

To enable inside NAT on a virtual interface, enter commands such as the following:

```
HP9300(config)# interface ve 1
HP9300(config-vif-1)# ip nat inside
```

This command enables inside NAT on virtual interface 4.

Enabling Outside NAT

To enable outside NAT on the interface attached to public addresses, use the following CLI method.

USING THE CLI

To enable outside NAT on an interface, enter commands such as the following:

```
HP9300(config)# interface ethernet 1/2
HP9300(config-if-1/2)# ip nat outside
```

This command enables outside NAT on Ethernet port 1/2.

Syntax: [no] ip nat outside

To enable outside NAT on a virtual interface, enter commands such as the following:

```
HP9300(config)# interface ve 2
HP9300(config-vif-2)# ip nat outside
```

This command enables outside NAT on virtual interface 4.

Changing Translation Table Timeouts

The NAT translation table contains all the currently active NAT translation entries on the device. An active entry is one that the device created for a private address when that client at that address sent traffic to the Internet. NAT performs the following steps to provide an address translation for a source IP address:

- The feature looks in the NAT translation table for an active NAT entry for the translation. If the table contains an active entry for the session, the device uses that entry.
- If NAT does not find an active entry in the NAT translation table, NAT creates an entry and places the entry in the table. The entry remains in the table until the entry times out.

Each NAT entry remains in the NAT translation table until the entry ages out. The age timers apply globally to all interfaces on which NAT is enabled.

- Dynamic timeout – This age timer applies to all entries (static and dynamic) that do not use Port Address Translation. The default is 120 seconds.
- UDP timeout – This age timer applies to entries that use Port Address Translation based on UDP port numbers. The default is 120 seconds.
- TCP timeout – This age timer applies to entries that use Port Address Translation based on TCP port numbers. The default is 120 seconds.

NOTE: This timer applies only to TCP sessions that do not end “gracefully”, with a TCP FIN or TCP RST.

- TCP FIN/RST timeout – This age timer applies to TCP FIN (finish) and RST (reset) packets, which normally terminate TCP connections. The default is 120 seconds.

NOTE: This timer is not related to the TCP timeout. The TCP timeout applies to packets to or from a host address that is mapped to an global IP address and a TCP port number (Port Address Translation feature). The TCP FIN/RST timeout applies to packets that terminate a TCP session, regardless of the host address or whether Port Address Translation is used.

- DNS timeout – This age timer applies to connections to a Domain Name Server (DNS). The default is 120 seconds.

To change the timeout for a dynamic entry type, use the following CLI method.

USING THE CLI

To change the age timeout for all entries that do not use Port Address Translation to 1800 seconds (one half hour), enter a command such as the following at the global CONFIG level of the CLI:

```
HP 9304M or HP 9308M(config)# ip nat timeout 1800
```

Syntax: [no] ip nat translation timeout | udp-timeout | tcp-timeout | finrst-timeout | dns-timeout <secs>

Use one of the following parameters to specify the dynamic entry type:

- **timeout** – All entries that do not use Port Address Translation. The default is 120 seconds.
- **udp-timeout** – Dynamic entries that use Port Address Translation based on UDP port numbers. The default is 120 seconds.
- **tcp-timeout** – Dynamic entries that use Port Address Translation based on TCP port numbers. The default is 120 seconds.
- **finrst-timeout** – TCP FIN (finish) and RST (reset) packets, which normally terminate TCP connections. The default is 120 seconds.
- **dns-timeout** – Connections to a Domain Name Server (DNS). The default is 120 seconds.

The <secs> parameter specifies the number of seconds. For each entry type, you can enter a value from 1 – 3600.

Displaying the Active NAT Translations

To display the currently active NAT translations, display the NAT translation table using the following CLI method.

NOTE: For information about the aging timer for NAT translation entries, see “Changing Translation Table Timeouts” on page 11-7.

USING THE CLI

To display the currently active NAT translations, enter the following command at any level of the CLI:

```
HP9300(config)# show ip nat translation
Pro Inside global      Inside local       Outside local      Outside global
--- 209.157.1.69     10.10.10.69       207.195.2.12      207.195.2.12
```

```
--- 209.157.1.72     10.10.10.2       207.195.4.69      207.195.4.69
```

Syntax: show ip nat translation

The **show ip nat translation** command shows the following information.

Table 11.1: CLI Display of Active NAT Translations

This Field...	Displays...
Pro	When Port Address Translation is enabled, this field indicates the protocol NAT is using to uniquely identify the host. NAT can map the same IP address to multiple hosts and use the protocol port to distinguish among the hosts. This field can have one of the following values: • tcp – In addition to this IP address, NAT is associating a TCP port with the host on the private network. • udp – In addition to this IP address, NAT is associating a UDP port with the host on the private network.
Inside global	The Internet address mapped to the private address listed in the Inside local field for inside NAT.
Inside local	The private address mapped to the Internet private address listed in the Inside global field for inside NAT.
Outside global	The destination of the traffic. If Port Address Translation is enabled, the TCP or UDP port also is shown.
Outside local	In the current release, the same as Outside global.

Displaying NAT Statistics

To display NAT statistics, use the following CLI method.

USING THE CLI

To display the NAT statistics, enter the following command at any level of the CLI:

```
HP9300(config)# show ip nat statistics

Total translations: 10 (0 static, 10 dynamic)
Hits: 10 Misses: 1
Expired translations: 1
Dynamic mappings:
 pool rtrpool: mask = 255.255.255.255
     start 192.168.2.79 end 192.168.2.79
     total addresses 1 overloaded
IP Fragments: saved 0, restored 0, timed out 0
Sess: Total 524288, Avail 524243, NAT 22

Inside global      Last Inside Local  xmit pkts  xmit bytes rx pkts    rx bytes  cnt
192.168.2.79       10.10.100.18       62         4012       42         4285      10
```

Syntax: show ip nat statistics

The **show ip nat statistics** command shows the following information.

Table 11.2: CLI Display of NAT Statistics

<table>
<tr><th>This Field...</th><th>Displays...</th></tr>
<tr><td>Total translations</td><td>The number of translations that are currently active. This number changes when translations are added or age out. To display the currently active translations, enter the show ip nat translation command.</td></tr>
<tr><td>Hits</td><td>The number of times NAT searched the translation table for a NAT entry and found the needed entry. (To optimize performance, NAT looks in the NAT table for an existing entry for a given translation before creating an entry for that translation.)</td></tr>
<tr><td>Misses</td><td>The number of times NAT did not find a needed entry in the translation table. When this occurs, NAT creates the needed entry and places it in the table.</td></tr>
<tr><td>Expired translations</td><td>The total number of dynamic translations that have aged of the translation table since the HP device was booted.</td></tr>
<tr><td>Dynamic mappings</td><td>Lists the dynamic translation parameters configured for the device. The following information is displayed:
pool – The name of the pool from which the address used for the translation was drawn.
mask – The sub-net mask or prefix used for addressed in the pool.
start – The beginning (lowest) IP address in the pool.
end – The ending (highest) IP address in the pool.
total addresses – The total number of active address translations that are based on addresses in this pool.

In addition, if the pool uses the Port Address Translation feature, the word “overloaded” appears at the end of this row.</td></tr>
<tr><td>IP Fragments</td><td>Lists statistics for fragmented packets:
saved – The number of out-of-sequence IP fragments saved.
restored – The number of saved out-of-sequence IP fragments that were successfully forwarded.
timed out – The number of saved out-of-sequence IP fragments that were dropped because the first IP fragment was never received.</td></tr>
</table>

Table 11.2: CLI Display of NAT Statistics (Continued)

This Field...	Displays...
Sess	Lists session statistics. NAT uses the session table for managing the translations. • Total – The total number of both used and available internal session resources. • Avail – The number of free internal session resources. • NAT – The number of internal session resources currently used by NAT. For information about the session table, see "Layer 4 Session Table" on page 6-6.
Inside global	A global IP address.
Last Inside Local	The last inside local IP address to use the global IP address.
xmit pkts	The number of packets send out for this NAT global IP address from the inside to the outside network.
xmit bytes	The number of bytes send out for this NAT global IP address from the inside to the outside network.
rx pkts	The number of packets received from the outside network to the inside network for this NAT global IP address.
rx bytes	The number of bytes received from the outside network to the inside network for this NAT global IP address.
cnt	The number of session resources in use for the translation. **Note**: If the value is 0, then translation is not taking place. Check your configuration. For example, make sure you have enabled both inside NAT (on the interface to the private addresses) and outside NAT (on the interface to the Internet).

Clearing Translation Table Entries

In addition to the aging mechanism, the software allows you to manually clear entries from the NAT table. The software provides the following clear options:

- Clear all entries (static and dynamic)
- Clear an entry for a specific NAT entry based on the private and global IP addresses
- Clear an entry for a specific NAT entry based on the IP addresses and the TCP or UDP port number. Use this option when you are trying to clear specific entries created using the Port Address Translation feature.

To clear entries, use the following CLI method.

USING THE CLI

To clear all dynamic entries from the NAT translation table, enter the following command at the Privileged EXEC level of the CLI:

```
HP9300# clear ip nat all
```

Syntax: clear ip nat all

To clear only the entries for a specific address entry, enter a command such as the following:

```
HP9300# clear ip nat inside 209.157.1.43 10.10.10.5
```

This command clears the inside NAT entry that maps private address 10.10.10.5 to Internet address 209.157.1.43. Here is the syntax for this form of the command.

Syntax: clear ip nat inside <global-ip> <private-ip>

If you use Port Address Translation, you can selectively clear entries based on the TCP or UDP port number assigned to an entry by the feature. For example, the following command clears one of the entries associated with Internet address 209.157.1.44 but does not clear other entries associated with the same address.

```
HP 9304M or HP 9308M# clear ip nat inside 209.157.1.43 1081 10.10.10.5 80
```

The command above clears all inside NAT entries that match the specified global IP address, private IP address, and TCP or UDP ports.

Syntax: clear ip nat <protocol> inside <global-ip> <internet-tcp/udp-port> <private-ip> <private-tcp/udp-port>

The <protocol> parameter specifies the protocol type and can be **tcp** or **udp**.

NAT Debug Commands

To configure the device to display diagnostic information for NAT, enter a **debug ip nat** command.

Syntax: [no] debug ip nat icmp | tcp | udp <ip-addr>

Syntax: [no] debug ip nat transdata

The <ip-addr> parameter specifies an IP address. The address applies to packets with the address as the source or the destination. Specify 0.0.0.0 to enable the diagnostic mode for all addresses.

The following examples show sample output from **debug ip nat** commands. The first three examples show the output from the diagnostic mode for ICMP NAT, TCP NAT, and UDP NAT. The fourth command shows the output for the diagnostic mode for NAT translation requests.

```
HP9300# debug ip nat icmp 192.168.3.11
NAT: ICMP debugging is on
NAT: icmp src 10.10.100.18 => trans 192.168.2.78 dst 192.168.3.11
NAT: ICMP src 10.10.100.18 => trans 192.168.2.78 dst 192.168.3.11
NAT: 192.168.2.78 192.168.3.11 ID 60950 len 60 txfid 13 icmp (8/0/512/13824)
NAT: ICMP dest 192.168.2.78 => trans 192.168.3.11 dst 10.10.100.18
NAT: 192.168.3.11 10.10.100.18 ID 5571 len 60 txfid 15 icmp (0/0/512/13824)
NAT: icmp src 10.10.100.18 => trans 192.168.2.78 dst 192.168.3.11
NAT: ICMP src 10.10.100.18 => trans 192.168.2.78 dst 192.168.3.11
NAT: 192.168.2.78 192.168.3.11 ID 61206 len 60 txfid 13 icmp (8/0/512/14080)
NAT: ICMP dest 192.168.2.78 => trans 192.168.3.11 dst 10.10.100.18
NAT: 192.168.3.11 10.10.100.18 ID 5572 len 60 txfid 15 icmp (0/0/512/14080)
NAT: icmp src 10.10.100.18 => trans 192.168.2.78 dst 192.168.3.11
NAT: ICMP src 10.10.100.18 => trans 192.168.2.78 dst 192.168.3.11
NAT: 192.168.2.78 192.168.3.11 ID 61462 len 60 txfid 13 icmp (8/0/512/14336)
NAT: ICMP dest 192.168.2.78 => trans 192.168.3.11 dst 10.10.100.18
NAT: 192.168.3.11 10.10.100.18 ID 5573 len 60 txfid 15 icmp (0/0/512/14336)
```

```
HP9300# debug ip nat tcp 192.168.3.11
NAT: TCP debugging is on
NAT: tcp src 10.10.100.18:1144 => trans 192.168.2.78:8012 dst 192.168.3.11:53
NAT: tcp data src 10.10.100.18:1144 => trans 192.168.2.78:8012 dst 192.168.3.11:53
NAT: 192.168.2.78:8012 192.168.3.11:53 flags S ID 64534 len 44 txfid 13
NAT: tcp data dest 192.168.2.78:8012 => trans 192.168.3.11:53 dst 10.10.100.18:1144
NAT: 192.168.3.11:53 10.10.100.18:1144 flags S A ID 64921 len 44 txfid 15
NAT: tcp data src 10.10.100.18:1144 => trans 192.168.2.78:8012 dst 192.168.3.11:53
NAT: 192.168.2.78:8012 192.168.3.11:53 flags A ID 64790 len 40 txfid 13
NAT: tcp data src 10.10.100.18:1144 => trans 192.168.2.78:8012 dst 192.168.3.11:53
NAT: 192.168.2.78:8012 192.168.3.11:53 flags A ID 65046 len 78 txfid 13
NAT: tcp data dest 192.168.2.78:8012 => trans 192.168.3.11:53 dst 10.10.100.18:1144
NAT: 192.168.3.11:53 10.10.100.18:1144 flags A ID 64922 len 147 txfid 15
```

```
NAT: tcp data src 10.10.100.18:1144 => trans 192.168.2.78:8012 dst 192.168.3.11:53
NAT: 192.168.2.78:8012 192.168.3.11:53 flags A ID 65302 len 40 txfid 13
NAT: tcp data src 10.10.100.18:1144 => trans 192.168.2.78:8012 dst 192.168.3.11:53
NAT: 192.168.2.78:8012 192.168.3.11:53 flags FA ID 23 len 40 txfid 13
NAT: tcp data dest 192.168.2.78:8012 => trans 192.168.3.11:53 dst 10.10.100.18:1144
NAT: 192.168.3.11:53 10.10.100.18:1144 flags A ID 64923 len 40 txfid 15
NAT: tcp data dest 192.168.2.78:8012 => trans 192.168.3.11:53 dst 10.10.100.18:1144
NAT: 192.168.3.11:53 10.10.100.18:1144 flags FA ID 64924 len 40 txfid 15
NAT: tcp data src 10.10.100.18:1144 => trans 192.168.2.78:8012 dst 192.168.3.11:53
NAT: 192.168.2.78:8012 192.168.3.11:53 flags A ID 279 len 40 txfid 13
```

```
HP9300# debug ip nat udp 192.168.3.11
NAT: udp src 10.10.100.18:1140 => trans 192.168.2.78:8008 dst 192.168.3.11:53
NAT: udp data src 10.10.100.18:1140 => trans 192.168.2.78:8008 dst 192.168.3.11:53
NAT: 192.168.2.78:8008 192.168.3.11:53 ID 54806 len 63 txfid 13
NAT: udp src 10.10.100.18:1141 => trans 192.168.2.78:8009 dst 192.168.3.11:53
NAT: udp data src 10.10.100.18:1141 => trans 192.168.2.78:8009 dst 192.168.3.11:53
NAT: 192.168.2.78:8009 192.168.3.11:53 ID 55062 len 63 txfid 13
NAT: udp data dest 192.168.2.78:8008 => trans 192.168.3.11:53 dst 10.10.100.18:1140
NAT: 192.168.3.11:53 10.10.100.18:1140 ID 56965 len 246 txfid 15
NAT: udp data dest 192.168.2.78:8009 => trans 192.168.3.11:53 dst 10.10.100.18:1141
NAT: 192.168.3.11:53 10.10.100.18:1141 ID 56966 len 246 txfid 15
```

```
HP9300# debug ip nat transdata
NAT: icmp src 10.10.100.18:2048 => trans 192.168.2.79 dst 204.71.202.127
NAT: udp  src 10.10.100.18:1561 => trans 192.168.2.79:65286 dst 192.168.3.11:53
NAT: tcp  src 10.10.100.18:1473 => trans 192.168.2.78:8016 dst 192.168.2.158:53
```

To disable the NAT diagnostic mode, enter a command such as the following:

```
HP9300# no debug ip nat tcp
```

This command disables the diagnostic mode for NAT performed on TCP packets. NAT diagnostics for other types of packets remain enabled.

You also can use the following syntax to disable the diagnostic mode for NAT:

Syntax: undebug ip nat icmp | tcp | udp | transdata

Configuration Examples

This section shows two complete configuration examples for NAT. The examples are based on different network topologies.

- NAT clients connected to the routing switch by a switch.
- NAT clients connected directly to routing switch ports.

NOTE: You also can enable the feature on the primary port of a trunk group, in which case the feature applies to all the ports in the trunk group. These examples do not show this configuration.

Private NAT Clients Connected to the routing switch by a switch

Figure 11.2 shows an example of a NAT configuration in which the clients in the private network are attached to the routing switch through a switch.

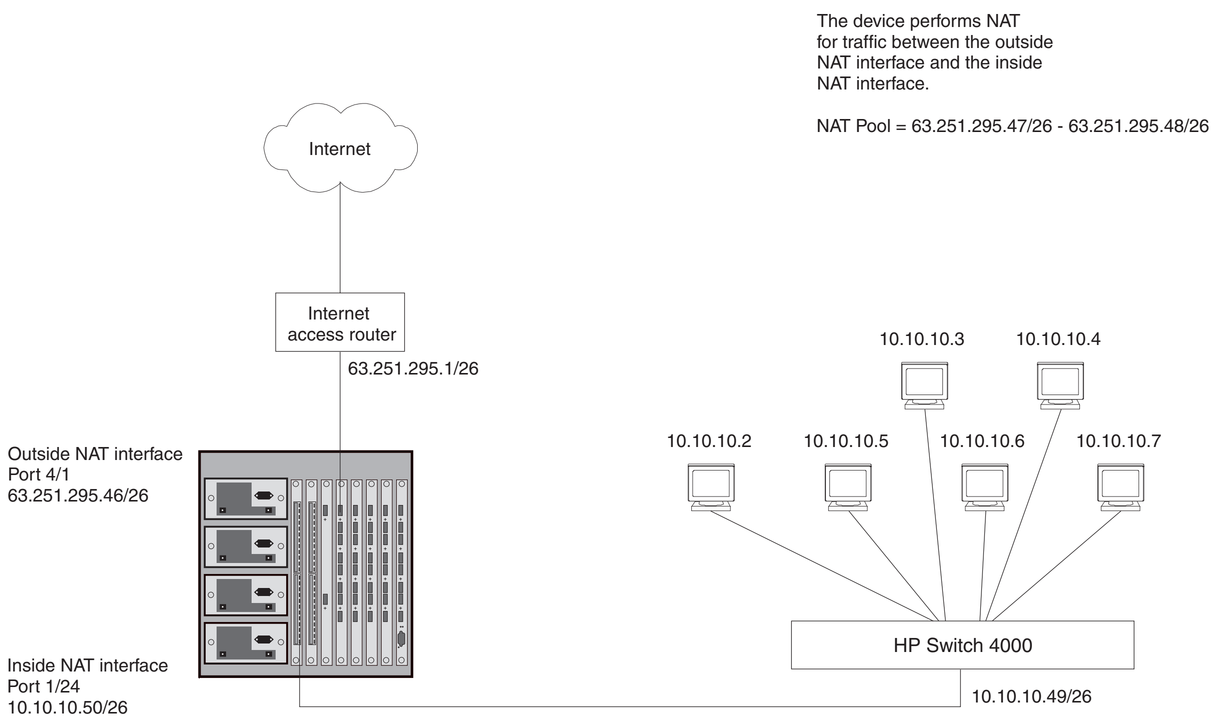


Figure 11.2 NAT clients connected the routing switch by a switch

Here are the CLI commands for implementing the NAT configuration for the HP 9308M shown in Figure 11.3. These commands configure the following:

- An Access Control List (ACL) for the range of private addresses in the private network on virtual interface 10
- A Pool of public (Internet) address to use for translation of the private addresses
- An association of the ACL for the private addresses with the pool for translation
- A default route that has the Internet access router as the route's next-hop gateway

The commands also enable inside NAT and outside NAT on the ports connected to the private network's switch and to the Internet access router, and save the configuration changes to the startup-config file.

Routing Switch Commands

The following commands access the configuration level of the CLI.

```
HP9300> en
HP9300# configure terminal
HP9300(config)#
```

The following command configures an ACL to identify the range of private addresses for which you want to provide NAT services. This ACL identifies the private address range as 10.10.10.0 – 10.10.10.255.

```
HP9300(config)# access-list 9 permit 10.10.10.0 0.0.0.255
```

NOTE: The format of the network mask for an ACL uses zeroes to indicate a value that must match, and ones (255 in decimal) as a wildcard. In this case, 0.0.0.255 means the first three parts of the IP address must match exactly, but the fourth part can have any value.

The following command configures the NAT address pool. The routing switch translates a client's address from the private network to an address from this pool when the client sends traffic to a public network, in this case a network located somewhere on the Internet.

```
HP9300(config)# ip nat pool np1 63.251.295.47 63.251.295.48 netmask 255.255.255.192
```

This command configures a pool named "np1", and adds public address range 63.251.295.47/26 – 63.251.295.48/26 to the pool. Generally, a pool contains more than two addresses, but this pool is small so that this configuration can also demonstrate the Port Address Translation feature.

The following command associates the range of private addresses identified by the ACL with the pool, and in this case also enables the Port Address Translation feature. Port Address Translation allows you to use an address pool that contains fewer addresses than the number of NAT clients in the private network.

```
HP9300(config)# ip nat inside source list 9 pool np1 overload
```

The **inside source list 9** portion of the command identifies the range of source addresses. The value "9" is the number of the ACL configured above. The **pool np1** portion of the command identifies the IP address pool configured above. The **overload** parameter enables Port Address Translation. When this feature is enabled, NAT associates a TCP or UDP port number with the public address for a client. In this case, there are four clients but only two addresses in the pool. Port Address Translation allows NAT to provide translation addresses for all four clients. When two translation clients have the same public IP address, the software can still distinguish between the clients because each client has a unique TCP or UDP port number.

The following command configures a static default route to the Internet access router. The routing switch uses this route for traffic that is addressed to a destination for which the IP route table does not have an explicit route. Typically, the IP route table does not have explicit routes to all destination networks on the Internet.

```
HP9300(config)# ip route 0.0.0.0 0.0.0.0 63.251.295.1
```

The address 0.0.0.0 0.0.0.0 is the standard notation for an IP default route. The 63.251.295.1 address is the address of the next-hop gateway for the route. In this case, the next-hop gateway is the routing switch's IP interface with Internet access router.

The following commands change to the configuration level for port 1/24, configure an IP address on the port, and enable inside NAT on the port. Port 1/24 connects the routing switch to the switch, which is connected to the private network containing the NAT clients.

```
HP9300(config)# interface ethernet 1/24
HP9300(config-if-1/24)# ip address 10.10.10.50 255.255.255.192
HP9300(config-if-1/24)# ip nat inside
HP9300(config-if-1/24)# exit
```

The following commands change to the configuration level for port 4/1, configure an IP address on the port, and enable outside NAT on the port. Port 4/1 connects the routing switch to the Internet access device.

```
HP9300(config)# interface ethernet 4/1
HP9300(config-if-4/1)# ip address 63.251.295.46 255.255.255.192
HP9300(config-if-4/1)# ip nat outside
v(config-if-4/1)# exit
```

The following command saves all the configuration changes above to the routing switch's startup-config file on flash memory. The routing switch applies NAT configuration information as soon as you enter it into the CLI. Saving the changes to the startup-config file ensures that the changes are reinstated following a system reload.

```
HP 9304M or HP 9308M(config)# write memory
```

Private NAT Clients Connected Directly to the routing switch

Figure 11.3 shows an example of a NAT configuration in which the NAT clients on the private network are directly connected to the routing switch. The configuration commands are similar to those for the configuration in "Private NAT Clients Connected to the routing switch by a switch" on page 11-14, except the inside NAT and outside NAT interfaces are virtual routing interfaces (called virtual interfaces or "VEs") instead of physical ports.

Since all the clients are in the same sub-net, the routing switch is configured with a virtual interface to serve as the inside NAT interface, the routing switch's IP interface for the NAT clients who have private addresses.

The virtual interface is required because you cannot configure IP addresses in the same sub-net on multiple physical interfaces on the routing switch. A virtual interface is a logical interface that allows you to associate the same IP address (the IP address of the virtual interface) with multiple physical ports.

You can use a virtual interface for routing only when you add the interface to a port-based VLAN. A port-based VLAN is a separate Layer 2 broadcast domain, a logical switch within the HP device. The routing switch uses virtual interfaces to route Layer 3 traffic between port-based VLANs. Thus, this configuration also includes configuration of separate port-based VLANs for the clients' inside NAT interface and for the outside NAT interface.

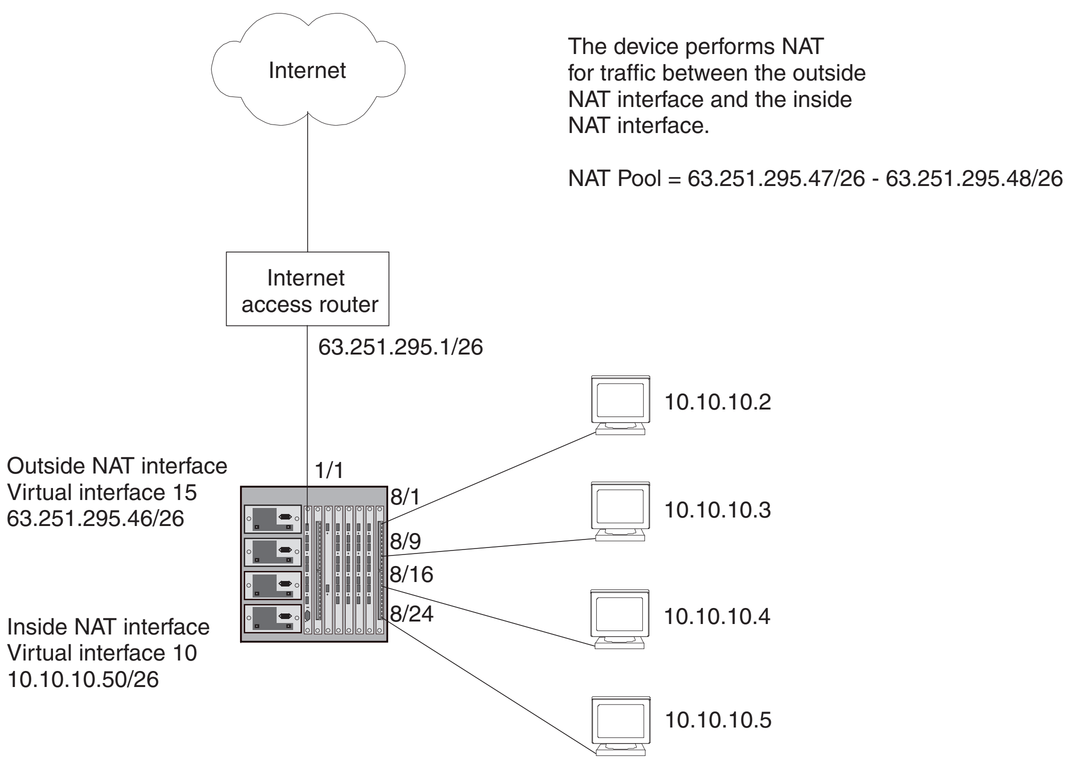


Figure 11.3 NAT clients connected directly to the routing switch

Here are the CLI commands for implementing the NAT configuration shown in Figure 11.3. These commands configure the following:

- Port-based VLAN 2 and virtual interface 10 for the inside NAT interface
- Port-based VLAN 3 and virtual interface 15 for the outside NAT interface
- An Access Control List (ACL) for the range of private address in the private network on virtual interface 10

- A Pool of public (Internet) address to use for translation of the private addresses
- An association of the ACL for the private addresses with the pool for translation
- A default route that has the Internet access router as the route's next-hop gateway

The commands also enable inside NAT and outside NAT on the virtual interfaces and save the configuration changes to the startup-config file. All the commands are entered on the routing switch.

The following commands access the configuration level of the CLI, then configure port-based VLAN 2 and add virtual interface 10 to the VLAN.

```
HP9300> en
HP9300# configure terminal
HP9300(config)# vlan 2 by port
HP9300(config-vlan-2)# untagged ethernet 8/1 to 8/24
HP9300(config-vlan-2)# router-interface ve 10
HP9300(config-vlan-2)# exit
```

These commands add ports 8/1 through 8/24 as untagged ports to port-based VLAN 2. Generally, unless a port is a member of more than one port-based VLAN, you do not need to tag the port. The **router-interface 10** command adds virtual interface 10. At this point the virtual interface does not have an IP address associated with it.

The following commands add port-based VLAN 3 and add virtual interface 15 to the VLAN.

```
HP9300(config)# vlan 3 by port
HP9300(config-vlan-3)# untagged ethernet 1/1
HP9300(config-vlan-3)# router-interface ve 15
HP9300(config-vlan-3)# exit
```

The following command configures an ACL to identify the range of private addresses for which you want to provide NAT services. This ACL identifies the private address range as 10.10.10.0 – 10.10.10.255.

```
HP9300(config)# access-list 9 permit 10.10.10.0 0.0.0.255
```

NOTE: The format of the network mask for an ACL uses zeroes to indicate a value that must match, and ones (255 in decimal) as a wildcard. In this case, 0.0.0.255 means the first three parts of the IP address must match exactly, but the fourth part can have any value.

The following command configures the NAT address pool. The routing switch translates a client's address from the private network to an address from this pool when the client sends traffic to a public network, in this case a network located somewhere on the Internet.

```
HP9300(config)# ip nat pool np1 63.251.295.47 63.251.295.48 netmask 255.255.255.192
```

This command configures a pool named "np1", and adds public address range 63.251.295.47/26 – 63.251.295.48/26 to the pool. Generally, a pool contains more than two addresses, but this pool is small so that this configuration can also demonstrate the Port Address Translation feature.

The following command associates the range of private addresses identified by the ACL with the pool, and in this case also enables the Port Address Translation feature. Port Address Translation allows you to use an address pool that contains fewer addresses than the number of NAT clients in the private network.

```
HP9300(config)# ip nat inside source list 9 pool np1 overload
```

The **inside source list 9** portion of the command identifies the range of source addresses. The value "9" is the number of the ACL configured above. The **pool np1** portion of the command identifies the IP address pool configured above. The **overload** parameter enables Port Address Translation. When this feature is enabled, NAT associates a TCP or UDP port number with the public address for a client. In this case, there are four clients but only two addresses in the pool. Port Address Translation allows NAT to provide translation addresses for all four clients. When two translation clients have the same public IP address, the software can still distinguish between the clients because each client has a unique TCP or UDP port number.

The following command configures a static default route to the Internet access router. The routing switch uses this route for traffic that is addressed to a destination for which the IP route table does not have an explicit route. Typically, the IP route table does not have explicit routes to all destination networks on the Internet.

```
HP9300(config)# ip route 0.0.0.0 0.0.0.0 63.251.295.1
```

The address 0.0.0.0 0.0.0.0 is the standard notation for an IP default route. The 63.251.295.1 address is the address of the next-hop gateway for the route. In this case, the next-hop gateway is the routing switch's IP interface with Internet access router.

The following commands configure an IP address on virtual interface 10, which is the virtual interface for the private network, and enable inside NAT on the interface.

```
HP9300(config)# interface ve 10
HP9300(config-ve-10)# ip address 10.10.10.50 255.255.255.192
HP9300(config-ve-10)# ip nat inside
HP9300(config-ve-10)# exit
```

The following commands configure an IP address on virtual interface 15, which is the interface to the Internet access router, and enable outside NAT on the interface.

```
HP9300(config)# interface ve 15
HP9300(config-ve-15)# ip address 63.251.295.46 255.255.255.192
HP9300(config-ve-15)# ip nat outside
HP9300(config-ve-15)# exit
```

The following command saves all the configuration changes above to the routing switch's startup-config file on flash memory. The routing switch applies NAT configuration information as soon as you enter it into the CLI. Saving the changes to the startup-config file ensures that the changes are reinstated following a system reload.

```
HP9300(config)# write memory
```

Chapter 12
Configuring VRRP and VRRPE

This chapter describes how to configure HP routing switches to configure the following router redundancy protocols:

- ***Virtual Router Redundancy Protocol (VRRP)*** – The standard router redundancy protocol described in RFC 2338.
- ***VRRP Extended (VRRPE)*** – An enhanced version of VRRP that overcomes limitations in the standard protocol.

NOTE: VRRP and VRRPE are separate protocols. You cannot use them together.

NOTE: You can use an HP routing switch configured for VRRP with another HP routing switch or a third-party router that is also configured for VRRP. You can use an HP routing switch configured for VRRPE only with another HP routing switch that also is configured for VRRPE.

Standby Router Protocol (SRP), an HP router redundancy protocol available before VRRP or VRRPE, is described in “Configuring SRP” on page 13-1.

For a summary of how these three router redundancy protocols differ, see “Comparison of VRRP, VRRPE, and SRP” on page 12-8.

Overview

The following sections describe VRRP and VRRPE. The protocols both provide redundant paths for IP addresses. However, the protocols differ in a few important ways. For clarity, each protocol is described separately.

Overview of VRRP

VRRP is a protocol that provides redundancy to routers within a LAN. VRRP allows you to provide alternate router paths for a host without changing the IP address or MAC address by which the host knows its gateway. Consider the situation shown in Figure 12.1.

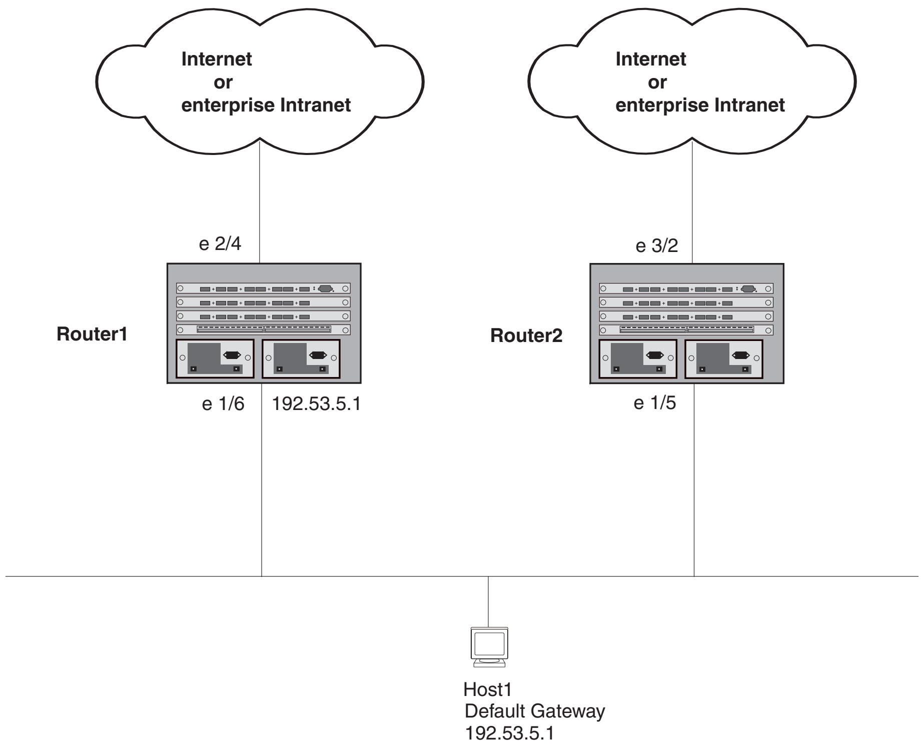


Figure 12.1 Router1 is Host1's default gateway but is a single point of failure

As shown in this example, Host1 uses 192.53.5.1 on Router1 as the host's default gateway out of the sub-net. If this interface goes down, Host1 is cut off from the rest of the network. Router1 is thus a single point of failure for Host1's access to other networks.

If Router1 fails, you could configure Host1 to use Router2. Configuring one host with a different default gateway might not require too much extra administration. However, consider a more realistic network with dozens or even hundreds of hosts per sub-net; reconfiguring the default gateways for all the hosts is impractical. It is much simpler to configure a VRRP virtual router on Router1 and Router2 to provide a redundant path for the host(s).

Figure 12.2 shows the same example network shown in Figure 12.1, but with a VRRP virtual router configured on Router1 and Router2.

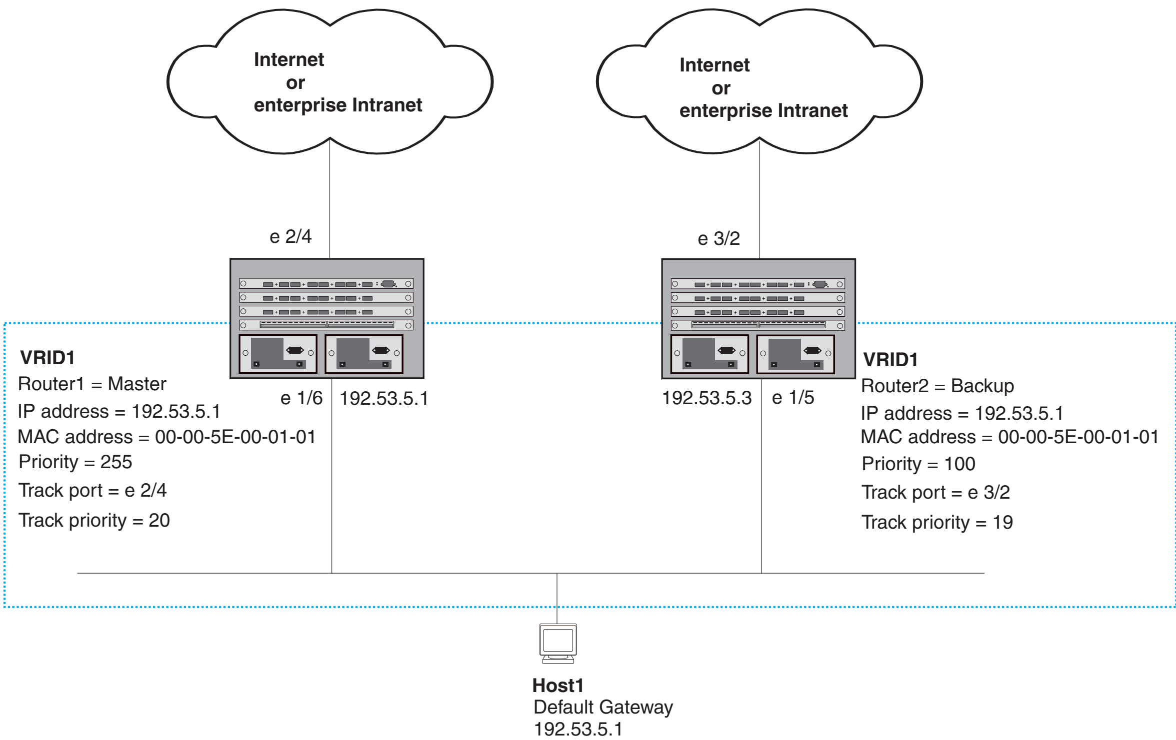


Figure 12.2 Router1 and Router2 are configured as a VRRP virtual router to provide redundant network access for Host1

The dashed box in Figure 12.2 represents a VRRP virtual router. When you configure a virtual router, one of the configuration parameters is the virtual router ID (VRID), which can be a number from 1 – 255. In this example, the VRID is 1. The VRID must be unique within the LAN. VRIDs do not cross LAN boundaries. Thus, there is no restriction against reusing a VRID with a different address mapping on different LANs.

NOTE: You can provide more redundancy by also configuring a second VRID with Router2 as the Owner and Router1 as the Backup. This type of configuration is sometimes called Multigroup VRRP.

Virtual Router ID (VRID)

A ***VRID*** consists of one Master router and one or more Backup routers. The Master router is the router that owns the IP address(es) you associate with the VRID. For this reason, the Master router is sometimes called the "Owner". Configure the VRID on the router that owns the default gateway interface. The other router in the VRID does not own the IP address(es) associated with VRID but provides the backup path if the Master router becomes unavailable.

Virtual Router MAC Address

Notice the MAC address associated with VRID1. The first five octets of the address are the standard MAC prefix for VRRP packets, as described in RFC 2338. The last octet is the VRID. THE VRID number becomes the final octet in the virtual MAC address associated with the virtual router.

When you configure a VRID, the software automatically assigns its MAC address. When a VRID becomes active, the Master router broadcasts a gratuitous ARP request containing the virtual router's MAC address for each IP address associated with the virtual router. In Figure 12.2, Router1 sends a gratuitous ARP with MAC address 00-00-5e-00-01-01 and IP address 192.53.5.1. Hosts use the virtual router's MAC address in routed traffic they send to their default IP gateway (in this example, 192.53.5.1).

Virtual Router IP Address

Unlike Standby Router Protocol (SRP), VRRP does not use virtual IP addresses. Thus, there is no virtual IP address associated with a virtual router. Instead, you associate the virtual router with one or more real interface IP addresses configured on the router that owns the real IP address(es). In Figure 12.2, the virtual router with VRID1 is associated with real IP address 192.53.5.1, which is configured on interface e1/6 on Router1. VRIDs are interface-level parameters, not system-level parameters, so the IP address you associate with the VRID must already be a real IP address configured on the Owner's interface.

NOTE: You also can associate a virtual router with a virtual interface. A virtual interface is a named set of physical interfaces. See "Configuring VLANs" on page 16-1 for more information.

When you configure the Backup router for the VRID, specify the same IP address as the one you specify on the Owner. This is the IP address used by the host as its default gateway. The IP address cannot also exist on the Backup router. The interface on which you configure the VRID on the Backup router must have an IP address in the same sub-net.

NOTE: If you delete a real IP address used by a VRRP entry, the VRRP entry also is deleted automatically.

NOTE: When a Backup takes over forwarding responsibilities from a failed Master router, the Backup forwards traffic addressed to the VRID MAC address, which the host believes is the MAC address of the router interface for its default gateway. However, the Backup cannot reply to IP pings sent to the IP address(es) associated with the VRID. Because the IP address(es) are owned by the Owner, if the Owner is unavailable, the IP addresses are unavailable as packet destinations.

Master Negotiation

The routers within a VRID use the VRRP priority values associated with each router to determine which router becomes the Master. When you configure the VRID on a router interface, you specify whether the router is the Owner of the IP address(es) you plan to associate with the VRID or a Backup. If you indicate that the router is the Owner of the IP address(es), the software automatically sets the router's VRRP priority for the VRID to 255, the highest VRRP priority. The router with the highest priority becomes the Master.

Backup routers can have a priority from 3 – 254, which you assign when you configure the VRID on the Backup router's interfaces. The default VRRP priority for Backup routers is 100.

Because the router that owns the IP addresses associated with the VRID always has the highest priority, when all the routers in the virtual router are operating normally, the negotiation process results in the Owner of the VRID's IP address(es) becoming the Master router. Thus, the VRRP negotiation results in the normal case, in which the hosts' path to the default route is to the router that owns the interface for that route.

Hello Messages

VRRP routers use Hello messages for negotiation to determine the Master router. VRRP routers send Hello messages to IP Multicast address 224.0.0.18. The frequency with which the Master sends Hello messages is the Hello Interval. Only the Master sends Hello messages. However, a Backup uses the Hello interval you configure for the Backup if it becomes the Master.

The Backup routers wait for a period of time called the Dead Interval for a Hello message from the Master. If a Backup router does not receive a Hello message by the time the dead interval expires, the Backup router assumes that the Master router is dead and negotiates with the other Backups to select a new Master router. The Backup router with the highest priority becomes the new Master.

If the Owner becomes unavailable, but then comes back online, the Owner again becomes the Master router. The Owner becomes the Master router again because it has the highest priority. The Owner always becomes the Master again when the Owner comes back online.

NOTE: If you configure a track port on the Owner and the track port is down, the Owner's priority is changed to the track priority. In this case, the Owner does not have a higher priority than the Backup that is acting as Master and the Owner therefore does not resume its position as Master. For more information about track ports, see "Track Ports and Track Priority" on page 12-5.

By default, if a Backup is acting as the Master, and the Master is still unavailable, another Backup can "preempt" the Backup that is acting as the Master. This can occur if the new Backup has a higher priority than the Backup who is acting as Master. You can disable this behavior if you want. When you disable preemption, a Backup router that has a higher priority than the router who is currently acting as Master does not preempt the new Master by initiating a new Master negotiation. See "Backup Preempt" on page 12-18.

NOTE: Regardless of the setting for the preempt parameter, the Owner always becomes the Master again when it comes back online.

Track Ports and Track Priority

The HP implementation of VRRP enhances the protocol by giving a VRRP router the capability to monitor the state of the interfaces on the other end of the route path through the router. For example, in Figure 12.2 on page 12-3, interface
e1/6 on Router1 owns the IP address to which Host1 directs route traffic on its default gateway. The exit path for this traffic is through Router1's e2/4 interface.

Suppose interface e2/4 goes down. Even if interface e1/6 is still up, Host1 is nonetheless cut off from other networks. In conventional VRRP, Router1 would continue to be the Master router despite the unavailability of the exit interface for the path the router is supporting. However, if you configure interface e1/6 to track the state of interface e2/4, if e2/4 goes down, interface e1/6 responds by changing Router1's VRRP priority to the value of the track priority. In the configuration shown in Figure 12.2 on page 12-3, Router1's priority changes from 255 to 20. One of the parameters contained in the Hello messages the Master router sends to its Backups is the Master router's priority. If the track port feature results in a change in the Master router's priority, the Backup routers quickly become aware of the change and initiate a negotiation for Master router.

In Figure 12.2 on page 12-3, the track priority results in Router1's VRRP priority becoming lower than Router2's VRRP priority. As a result, when Router2 learns that it now has a higher priority than Router1, Router2 initiates negotiation for Master router and becomes the new Master router, thus providing an open path for Host1's traffic. To take advantage of the track port feature, make sure the track priorities are always lower than the VRRP priorities. The default track priority for the router that owns the VRID IP address(es) is 2. The default track priority for Backup routers is 1. If you change the track port priorities, make sure you assign a higher track priority to the Owner of the IP address(es) than the track priority you assign on the Backup routers.

Suppression of RIP Advertisements for Backed Up Interfaces

The HP implementation also enhances VRRP by allowing you to configure the protocol to suppress RIP advertisements for the backed up paths from Backup routers. Normally, a VRRP Backup router includes route information for the interface it is backing up in RIP advertisements. As a result, other routers receive multiple paths for the interface and might sometimes unsuccessfully use the path to the Backup rather than the path to the Master. If you enable the HP implementation of VRRP to suppress the VRRP Backup routers from advertising the backed up interface in RIP, other routers learn only the path to the Master router for the backed up interface.

Authentication

The HP implementation of VRRP can use simple passwords to authenticate VRRP packets. The VRRP authentication type is not a parameter specific to the VRID. Instead, VRRP uses the authentication type associated with the interfaces on which you define the VRID. For example, if you configure your router interfaces to use a simple password to authenticate traffic, VRRP uses the same simple password and VRRP packets that do not contain the password are dropped. If your interfaces do not use authentication, neither does VRRP.

NOTE: The MD5 authentication type is not supported for VRRP.

Independent Operation of VRRP alongside RIP, OSPF, and BGP4

VRRP operation is independent of the RIP, OSPF, and BGP4 protocols. Their operation is unaffected when VRRP is enabled on a RIP, OSPF, or BGP4 interface.

Dynamic VRRP Configuration

All VRRP global and interface parameters take effect immediately. You do not need to reset the system to place VRRP configuration parameters into effect.

Overview of VRRPE

VRRPE is similar to VRRP, but differs in the following respects:

- Owners and Backups
  - VRRP has an Owner and one or more Backups for each VRID. The Owner is the router on which the VRID's IP address is also configured as a real address. All the other routers supporting the VRID are Backups.
  - VRRPE does not use Owners. All routers are Backups for a given VRID. The router with the highest priority becomes Master. If there is a tie for highest priority, the router with the highest IP address becomes Master. The elected Master owns the virtual IP address and answers ping and ARP requests and so on.
- VRID's IP address
  - VRRP requires that the VRID also be a real IP address configured on the VRID's interface on the Owner.
  - VRRPE requires only that the VRID be in the same sub-net as an interface configured on the VRID's interface. In fact, VRRPE does not allow you to specify a real IP address configured on the interface as the VRID IP address.
- VRID's MAC Address
  - VRRP source MAC is a virtual MAC address defined as 00-00-5E-00-01-<vrid>, where <vrid> is the VRID. The Master owns the Virtual MAC address.
  - VRRPE uses the interface's actual MAC address as the source MAC address. The MAC address is 02-E0-52-<hash-value>-<vrid>, where <hash-value> is a two-octet hashed value for the IP address and <vrid> is the VRID.
- Hello packets
  - VRRP sends Hello messages to IP Multicast address 224.0.0.18.
  - VRRPE uses UDP to send Hello messages in IP multicast messages. The Hello packets use the interface's actual MAC address and IP address as the source addresses. The destination MAC address is 01-00-5E-00-00-02, and the destination IP address is 224.0.0.2 (the well-known IP multicast address for "all routers"). Both the source and destination UDP port number is 8888. VRRP messages are encapsulated in the data portion of the packet.
- Track ports and track priority
  - VRRP changes the priority of the VRID to the track priority, which typically is lower than the VRID priority and lower than the VRID's priorities configured on the Backups. For example, if the VRRP interface's priority is 100 and a tracked interface with track priority 20 goes down, the software changes the VRRP interface's priority to 20.
  - VRRPE reduces the priority of a VRRPE interface by the amount of a tracked interface's priority if the tracked interface's link goes down. For example, if the VRRPE interface's priority is 100 and a tracked interface with track priority 20 goes down, the software changes the VRRPE interface's priority to 80. If another tracked interface goes down, the software reduces the VRID's priority again, by the amount of the tracked interface's track priority.

The most important difference is that all VRRPE routers are Backups. There is no Owner router. VRRPE overcomes the limitations in standard VRRP by removing the Owner.

Figure 12.3 shows an example of a VRRPE configuration.

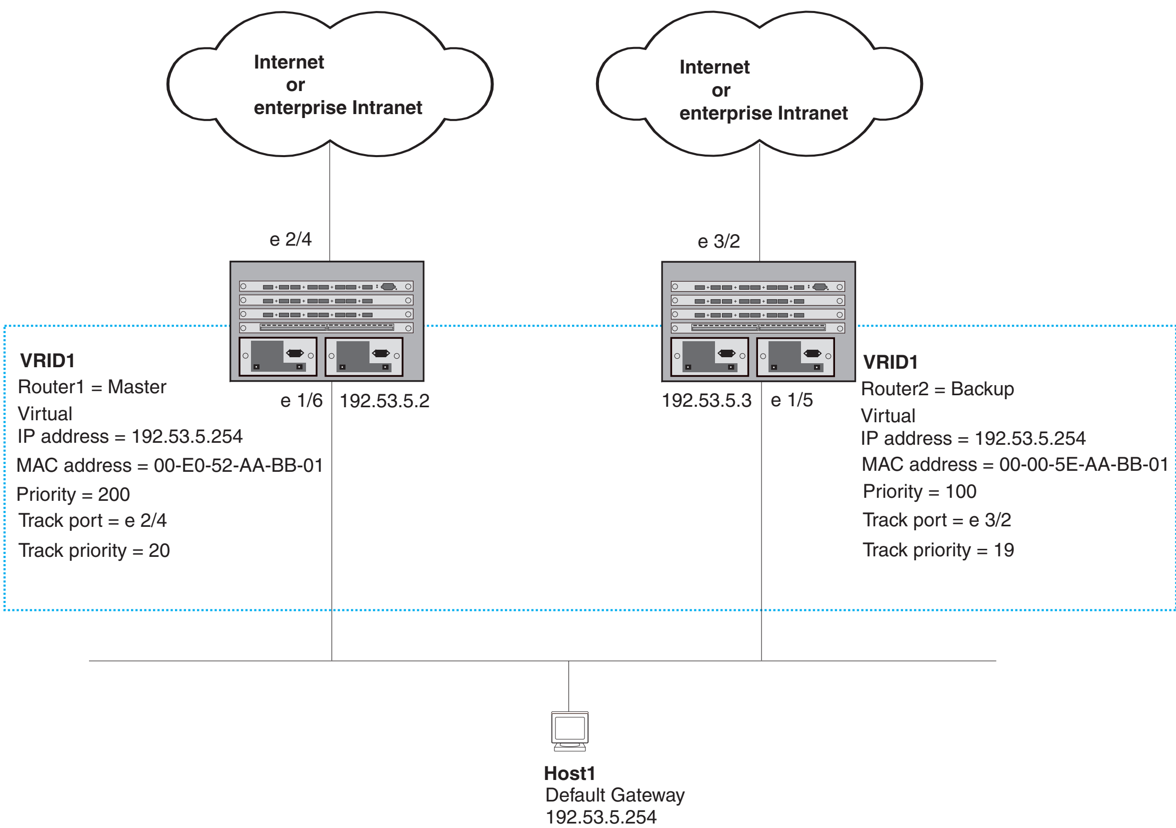


Figure 12.3 Router1 and Router2 are configured as a VRRPE virtual router to provide redundant network access for Host1

This configuration is similar to the one shown in Figure 12.2 on page 12-3. The differences between the two configurations are based on the architectural differences between VRRP and VRRPE:

- The virtual IP address is not a real IP address configured on one of the VRID interfaces. In Figure 12.2 on page 12-3, the virtual IP address is also a real IP address configured on port 1/6 on the router on the left, which automatically makes the router the Owner of the virtual IP address and gives the router priority 255 for the VRID.
- The VRID MAC address has the format 02-E0-52-<hash-value>-<vrid>, where <hash-value> is a two-octet hashed value for the IP address and <vrid> is the VRID.
- The priority for the router on the right is 100, which is the default priority for Backups in VRRP and VRRPE. However, the priority for the router on the left is 200. In this case, the priority has been changed during configuration from the default value to 200. In Figure 12.2 on page 12-3, the router on the left has priority 255, the default priority for the Owner of the real IP address shared by the virtual IP address. In VRRPE, none of the VRID interfaces are configured with a real IP address that is the same as the virtual IP interface.

The other parameters are the same.

Comparison of VRRP, VRRPE, and SRP

This section compares HP's router redundancy protocols.

VRRP

VRRP is a standards-based protocol, described in RFC 2338. The HP implementation of VRRP contains the features in RFC 2338. The HP implementation also provides the following additional features:

- Track ports – An HP feature that enables you to diagnose the health of all the routing switch's ports used by the backed-up VRID, instead of only the port connected to the client sub-net. See "Track Ports and Track Priority" on page 12-5.
- Suppression of RIP advertisements on Backup routes for the backed up interface – You can enable the routing switches to advertise only the path to the Master router for the backed up interface. Normally, a VRRP Backup router includes route information for the interface it is backing up in RIP advertisements.

HP routing switches configured for VRRP can interoperate with third-party routers using VRRP.

VRRPE

VRRPE is an HP protocol that provides the benefits of VRRP without the limitations. In fact, VRRPE combines the benefits of HP's VRRP and SRP (see "SRP"). VRRPE is unlike VRRP and is like SRP in the following ways:

- There is no "Owner" router. You do not need to use an IP address configured on one of the routing switches as the virtual router ID (VRID), which is the address you are backing up for redundancy. The VRID is independent of the IP interfaces configured in the routing switches. As a result, the protocol does not have an "Owner" as VRRP does.
- There is no restriction on which router can be the default master router. In VRRP, the "Owner" (the routing switch on which the IP interface that is used for the VRID is configured) must be the default Master.

HP routing switches configured for VRRPE can interoperate only with other HP routing switches.

SRP

The ***Standby Router Protocol (SRP)*** is another HP router redundancy protocol that provides many of the same features as HP's implementation of VRRP and VRRPE. However, SRP does not provide authentication, which VRRP and VRRPE do. In addition, SRP allows only one backup router.

SRP is available only on HP routing switches.

Architectural Differences

The protocols have the following architectural differences.

Management Protocol

- VRRP – VRRP routers send VRRP Hello and Hello messages to IP Multicast address 224.0.0.18.
- VRRPE – VRRPE sends messages to destination MAC address 01-00-5E-00-00-02 and destination IP address 224.0.0.2 (the standard IP multicast address for "all routers").
- SRP – SRP sends management traffic to a user-configured unicast address.

Virtual Router IP Address (the address you are backing up)

- VRRP – The virtual router IP address is the same as an IP address or virtual interface configured on one of the routing switches, which is the "Owner" and becomes the default Master.
- VRRPE – The virtual router IP address is the gateway address you want to backup, but does not need to be an IP interface configured on one of the routing switch's ports or a virtual interface.
- SRP – The virtual router IP address is a user-configured virtual IP address.

Master and Backups

- VRRP – The “Owner” of the IP address of the VRID is the default Master and has the highest priority (255). The precedence of the Backups is determined by their priorities. The default Master is always the Owner of the IP address of the VRID.
- VRRPE – The Master and Backups are selected based on their priority. You can configure any of the routing switches to be the Master by giving it the highest priority. There is no Owner.
- SRP – You can configure one Primary Router and one Backup Router. There is no Owner. You must define the virtual IP address (the one you are backing up) on both the Primary Router and the Backup Router.

NOTE: If your HP routing switches already are using SRP and you do not need redundancy with devices that cannot use SRP, you do not need to reconfigure your routers to use VRRP or VRRPE.

Hewlett-Packard recommends that you do not use more than one redundancy protocol (VRRP, VRRPE, or SRP) on the same device.

VRRP and VRRPE Parameters

Table 12.1 lists the VRRP and VRRPE parameters. Most of the parameters and default values are the same for both protocols. The exceptions are noted in the table.

Table 12.1: VRRP and VRRPE Parameters

Parameter	Description	Default	See page...
Protocol	The Virtual Router Redundancy Protocol (VRRP) based on RFC 2338 or VRRP-Extended, HP’s enhanced implementation of VRRP	Disabled **Note**: Only one of the protocols can be enabled at a time.	12-12 12-13
VRRP or VRRPE router	The HP routing switch’s active participation as a VRRP or VRRPE router. Enabling the protocol does not activate the routing switch for VRRP or VRRPE. You must activate the device as a VRRP or VRRPE router after you configure the VRRP or VRRPE parameters.	Inactive	12-12 12-13
Virtual Router ID (VRID)	The ID of the virtual router you are creating by configuring multiple routers to back up an IP interface. You must configure the same VRID on each router that you want to use to back up the address. No default.	None	12-3 12-12 12-13

Table 12.1: VRRP and VRRPE Parameters (Continued)

Parameter	Description	Default	See page...
Virtual Router IP address	This is the address you are backing up. No default. • VRRP – The virtual router IP address must be a real IP address configured on the VRID interface on one of the VRRP routers. This router is the IP address Owner and is the default Master. • VRRPE – The virtual router IP address must be in the same sub-net as a real IP address configured on the VRRPE interface, but cannot be the same as a real IP address configured on the interface.	None	12-4 12-12 12-13
VRID MAC address	The source MAC address in VRRP or VRRPE packets sent from the VRID interface, and the destination for packets sent to the VRID. • VRRP – A virtual MAC address defined as 00-00-5e-00-01-<vrid>. The Master owns the Virtual MAC address. • VRRPE – A virtual MAC address defined as 02-E0-52-<hash-value>-<vrid>, where <hash-value> is a two-octet hashed value for the IP address and <vrid> is the VRID.	Not configurable	12-3
Authentication type	The type of authentication the VRRP or VRRPE routers use to validate VRRP or VRRPE packets. The authentication type must match the authentication type the VRID's port uses with other routing protocols such as OSPF. • No authentication – The interfaces do not use authentication. This is the VRRP default. • Simple – The interface uses a simple text-string as a password in packets sent on the interface. If the interface uses simple password authentication, the VRID configured on the interface must use the same authentication type and the same password. **Note**: MD5 is not supported by VRRP or VRRPE.	No authentication	12-5 12-14
Router type	Whether the router is an Owner or a Backup. • Owner (VRRP only) – The router on which the real IP address used by the VRID is configured. • Backup – Routers that can provide routing services for the VRID but do not have a real IP address matching the VRID.	VRRP – The Owner is always the router that has the real IP address used by the VRID. All other routers for the VRID are Backups. VRRPE – All routers for the VRID are Backups.	12-15

Table 12.1: VRRP and VRRPE Parameters (Continued)

Parameter	Description	Default	See page...
Backup priority	A numeric value that determines a Backup's preferability for becoming the Master for the VRID. During negotiation, the router with the highest priority becomes the Master. • VRRP – The Owner has the highest priority (255); other routers can have a priority from 3 – 254. • VRRPE – All routers are Backups and have the same priority by default. If two or more Backups are tied with the highest priority, the Backup interface with the highest IP address becomes the Master for the VRID.	VRRP – 255 for the Owner; 100 for each Backup VRRPE – 100 for all Backups	12-15
Suppression of RIP advertisements	A router that is running RIP normally advertises routes to a backed up VRID even when the router is not currently the active router for the VRID. Suppression of these advertisements helps ensure that other routers do not receive invalid route paths for the VRID.	Disabled	12-16
Hello interval	The number of seconds between Hello messages from the Master to the Backups for a given VRID. The interval can from 1 – 84 seconds.	One second	12-4 12-16
Dead interval	The number of seconds a Backup waits for a Hello message from the Master for the VRID before determining that the Master is no longer active. If the Master does not send a Hello message before the dead interval expires, the Backups negotiate (compare priorities) to select a new Master for the VRID.	Three times the Hello Interval plus one-half second	12-4 12-16
Backup Hello interval	The number of seconds between Hello messages from a Backup to the Master. The message interval can be from 60 – 3600 seconds. You must enable the Backup to send the messages. The messages are disabled by default on Backups. The current Master (whether the VRRP Owner or a Backup) sends Hello messages by default.	Disabled 60 seconds when enabled	12-4 12-17
Track port	Another routing switch port or virtual interface whose link status is tracked by the VRID's interface. If the link for a tracked interface goes down, the VRRP or VRRPE priority of the VRID interface is changed, causing the devices to renegotiate for Master.	None	12-5 12-17

Table 12.1: VRRP and VRRPE Parameters (Continued)

Parameter	Description	Default	See page...
Track priority	A VRRP or VRRPE priority value assigned to the tracked port(s). If a tracked port's link goes down, the VRID port's VRRP or VRRPE priority changes. • VRRP – The priority changes to the value of the tracked port's priority. • VRRPE – The VRID port's priority is reduced by the amount of the tracked port's priority.	VRRP – 2 VRRPE – 5	12-5 12-17
Backup preempt mode	Prevents a Backup with a higher VRRP priority from taking control of the VRID from another Backup that has a lower priority but has already assumed control of the VRID.	Enabled	12-18

Configuring Basic VRRP Parameters

To implement a simple VRRP configuration using all the default values, enter commands such as the following.

Configuring the Owner

```
Router1(config)# router vrrp
Router1(config)# inter e 1/6
Router1(config-if-1/6)# ip address 192.53.5.1
Router1(config-if-1/6)# ip vrrp vrid 1
Router1(config-if-1/6-vrid-1)# owner
Router1(config-if-1/6-vrid-1)# ip-address 192.53.5.1
Router1(config-if-1/6-vrid-1)# activate
```

Configuring a Backup

```
Router2(config)# router vrrp
Router2(config)# inter e 1/5
Router2(config-if-1/5)# ip address 192.53.5.3
Router2(config-if-1/5)# ip vrrp vrid 1
Router2(config-if-1/5-vrid-1)# backup
Router2(config-if-1/5-vrid-1)# ip-address 192.53.5.1
Router2(config-if-1/5-vrid-1)# activate
```

Configuration Rules for VRRP

- The interfaces of all routers in a VRID must be in the same IP sub-net.
- The IP address(es) associated with the VRID must already be configured on the router that will be the Owner router.
- An IP address(es) associated with the VRID must be on only one router.
- The Hello interval must be set to the same value on both the Owner and Backup(s) for the VRID.
- The Dead interval must be set to the same value on both the Owner and Backup(s) for the VRID.
- The track priority on a router must be lower than the router's VRRP priority. Also, the track priority on the Owner must be higher than the track priority on the Backup(s).

Configuring Basic VRRPE Parameters

To implement a simple VRRPE configuration using all the default values, enter commands such as the following on each routing switch.

```
Router2(config)# router vrrp-extended
Router2(config)# inter e 1/5
Router2(config-if-1/5)# ip address 192.53.5.3
Router2(config-if-1/5)# ip vrrp-extended vrid 1
Router2(config-if-1/5-vrid-1)# backup
Router2(config-if-1/5-vrid-1)# ip-address 192.53.5.254
Router2(config-if-1/5-vrid-1)# activate
```

NOTE: You also can use the **enable** command to activate the configuration. This command does the same thing as the **activate** command.

Configuration Rules for VRRPE

- The interfaces of all routers in a VRID must be in the same IP sub-net.
- The IP address(es) associated with the VRID cannot be configured on any of the routing switches.
- The Hello interval must be set to the same value on all the routing switches.
- The Dead interval must be set to the same value on all the routing switches.
- The track priority for a VRID must be lower than the VRRPE priority.

Note Regarding Disabling VRRP or VRRPE

If you disable VRRP or VRRPE, the routing switch removes all the configuration information for the disabled protocol from the running-config. Moreover, when you save the configuration to the startup-config file after disabling one of these protocols, all the configuration information for the disabled protocol is removed from the startup-config file.

The CLI displays a warning message such as the following:

```
HP9300(config-vrrp-router)# no router vrrp
router vrrp mode now disabled. All vrrp config data will be lost when writing to
flash!
```

The Web management interface does not display a warning message.

If you have disabled the protocol but have not yet saved the configuration to the startup-config file and reloaded the software, you can restore the configuration information by re-entering the command to enable the protocol (ex: **router vrrp**), or by selecting the Web management option to enable the protocol. If you have already saved the configuration to the startup-config file and reloaded the software, the information is gone.

If you are testing a VRRP or VRRPE configuration and are likely to disable and re-enable the protocol, you might want to make a backup copy of the startup-config file containing the protocol's configuration information. This way, if you remove the configuration information by saving the configuration after disabling the protocol, you can restore the configuration by copying the backup copy of the startup-config file onto the flash memory.

Configuring Additional VRRP and VRRPE Parameters

You can modify the following VRRP and VRRPE parameters on an individual VRID basis. These parameters apply to both protocols:

- Authentication type (if the interfaces on which you configure the VRID use authentication)
- Router type (Owner or Backup)

NOTE: For VRRP, change the router type only if you have moved the real IP address from one router to another or you accidentally configured the IP address Owner as a Backup.

For VRRPE, the router type is always Backup. You cannot change the type to Owner.

- Backup priority
- Suppression of RIP advertisements on Backup routes for the backed up interface
- Hello interval
- Dead interval
- Backup Hello messages and message timer (Backup advertisement)
- Track port
- Track priority
- Backup preempt mode

For VRRP, you can set some of these parameters using the VRRP configuration panel of the Web management interface, shown in “” on page 12-35. For information about the fields, see the parameter descriptions in the following sections. To access this panel, select VRRP from the System configuration sheet, then click Modify next to the VRRP entry you want to edit.

NOTE: You cannot set VRRPE parameters using the Web management interface.

See “VRRP and VRRPE Parameters” on page 12-9 for a summary of the parameters and their defaults.

Authentication Type

If the interfaces on which you configure the VRID use authentication, the VRRP or VRRPE packets on those interfaces also must use the same authentication. HP’s implementation of VRRP and VRRPE supports the following authentication types:

- No authentication – The interfaces do not use authentication. This is the default for VRRP and VRRPE.
- Simple – The interfaces use a simple text-string as a password in packets sent on the interface. If the interfaces use simple password authentication, the VRID configured on the interfaces must use the same authentication type and the same password.

USING THE CLI

To configure the VRID interface on Router1 for simple-password authentication using the password “ourpword”, enter the following commands:

Configuring Router 1

```
Router1(config)# inter e 1/6
Router1(config-if-1/6)# ip vrrp auth-type simple-text-auth ourpword
```

Configuring Router 2

```
Router2(config)# inter e 1/5
Router2(config-if-1/5)# ip vrrp auth-type simple-text-auth ourpword
```

VRRP Syntax

Syntax: ip vrrp auth-type no-auth | simple-text-auth <auth-data>

The **auth-type no-auth** parameter indicates that the VRID and the interface it is configured on do not use authentication.

The **auth-type simple-text-auth** <auth-data> parameter indicates that the VRID and the interface it is configured on use a simple text password for authentication. The <auth-data> parameter is the password. If you use this parameter, make sure all interfaces on all the routers supporting this VRID are configured for simple password authentication and use the same password.

VRRPE Syntax

Syntax: ip vrrp-extended auth-type no-auth | simple-text-auth <auth-data>

The parameter values are the same as for VRRP.

Router Type

A VRRP interface is either an Owner or a Backup for a given VRID. By default, the Owner becomes the Master following the negotiation. A Backup becomes the Master only if the Master becomes unavailable.

A VRRPE interface is always a Backup for its VRID. The Backup with the highest VRRP priority becomes the Master.

This section describes how to specify the interface type, how to change the type for VRRP, and how to set or change the interface's VRRP or VRRPE priority and track priority for the VRID.

NOTE: You can force a VRRP master router to abdicate (give away control) of the VRID to a Backup by temporarily changing the Master's VRRP priority to a value less than the Backup's. See "Forcing a Master Router To Abdicate to a Standby Router" on page 12-18.

NOTE: The type Owner is not applicable to VRRPE.

NOTE: The IP address(es) you associate with the Owner must be a real IP address (or addresses) on the interface on which you configure the VRID.

When you configure a Backup router, the router interface on which you are configuring the VRID must have a real IP address that is in the same sub-net as the address associated with the VRID by the Owner. However, the address cannot be the same.

USING THE CLI

To configure Router1 as a VRRP VRID's Owner, enter the following commands:

```
Router1(config)# inter e 1/6
Router1(config-if-1/6)# ip vrrp vrid 1
Router1(config-if-1/6-vrid-1)# owner
```

To configure Router2 as a VRRP Backup for the same VRID, enter the following commands:

```
Router2(config)# inter e 1/5
Router2(config-if-1/5)# ip vrrp vrid 1
Router2(config-if-1/5-vrid-1)# backup
```

To configure a VRRPE interface as a Backup for a VRID and set its VRRPE priority and track priority, enter commands such as the following:

```
HP9300(config)# inter e 1/1
HP9300(config-if-1/1)# ip vrrp-extended vrid 1
HP9300(config-if-1/1-vrid-1)# backup priority 50 track-priority 10
```

VRRP Syntax

Syntax: owner [track-priority <value>]

The **track-priority** <value> parameter changes the track-port priority for this interface and VRID from the default (2) to a value from 1 – 254.

Syntax: backup [priority <value>] [track-priority <value>]

The **priority** <value> parameter specifies the VRRP priority for this interface and VRID. You can specify a value from 3 – 254. The default is 100.

The **track-priority** <value> parameter is the same as above.

NOTE: You cannot set the priority of a VRRP Owner. The Owner's priority is always 255.

VRRPE Syntax

Syntax: backup [priority <value>] [track-priority <value>]

The software requires you to identify a VRRPE interface as a Backup for its VRID before you can activate the interface for the VRID. However, after you configure the VRID, you can use this command to change its priority or track priority. The parameter values are the same as for VRRP.

Suppression of RIP Advertisements on Backup Routers for the Backup Up Interface

Normally, a VRRP or VRRPE Backup includes route information for the virtual IP address (the backed up interface) in RIP advertisements. As a result, other routers receive multiple paths for the backed up interface and might sometimes unsuccessfully use the path to the Backup rather than the path to the Master.

You can prevent the Backups from advertising route information for the backed up interface by enabling suppression of the advertisements.

USING THE CLI

To suppress RIP advertisements for the backed up interface in Router2, enter the following commands:

```
Router2(config)# router rip
Router2(config-rip-router)# use-vrrp-path
```

Syntax: use-vrrp-path

The syntax is the same for VRRP and VRRPE.

Hello Interval

The Master periodically sends Hello messages to the Backups. The Backups use the Hello messages as verification that the Master is still on-line. If the Backup routers stop receiving the Hello messages for the period of time specified by the Dead interval, the Backup routers determine that the Master router is dead. At this point, the Backup router with the highest priority becomes the new Master router. The Hello interval can be from 1 – 84 seconds. The default is 1 second.

NOTE: The default Dead interval is three times the Hello Interval plus one-half second. Generally, if you change the Hello interval, you also should change the Dead interval on the Backup routers.

USING THE CLI

To change the Hello interval on the Master to 10 seconds, enter the following commands:

```
Router1(config)# inter e 1/6
Router1(config-if-1/6)# ip vrrp vrid 1
Router1(config-if-1/6-vrid-1)# hello-interval 10
```

Syntax: hello-interval <value>

The syntax is the same for VRRP and VRRPE.

Dead Interval

The Dead interval is the number of seconds a Backup waits for a Hello message from the Master before determining that the Master is dead. When Backups determine that the Master is dead, the Backup with the highest priority becomes the new Master. The Dead interval can be from 1 – 84 seconds. The default is 3.5 seconds. This is three times the default Hello interval (1 second) plus one-half second added by the router software. The software automatically adds one-half second to the Dead interval value you enter.

USING THE CLI

To change the Dead interval on a Backup to 30 seconds, enter the following commands:

```
Router2(config)# inter e 1/5
```

```
Router2(config-if-1/5)# ip vrrp vrid 1
Router2(config-if-1/5-vrid-1)# dead-interval 30
```

Syntax: dead-interval <value>

The syntax is the same for VRRP and VRRPE.

Backup Hello Message State and Interval

By default, Backup do not send Hello messages to advertise themselves to the Master. You can enable these messages if desired and also change the message interval.

USING THE CLI

To enable a Backup to send Hello messages to the Master, enter commands such as the following:

```
HP9300(config)# router vrrp
HP9300(config)# inter e 1/6
HP9300(config-if-1/6)# ip vrrp vrid 1
HP9300(config-if-1/6-vrid-1)# advertise backup
```

Syntax: [no] advertise backup

When you enable a Backup to send Hello messages, the Backup sends a Hello messages to the Master every 60 seconds by default. You can change the interval to be up to 3600 seconds. To do so, enter commands such as the following:

```
HP9300(config)# router vrrp
HP9300(config)# inter e 1/6
HP9300(config-if-1/6)# ip vrrp vrid 1
HP9300(config-if-1/6-vrid-1)# backup-hello-interval 180
```

Syntax: [no] backup-hello-interval <num>

The <num> parameter specifies the message interval and can be from 60 – 3600 seconds. The default is 60 seconds.

The syntax is the same for VRRP and VRRPE.

Track Port

You can configure the VRID on one interface to track the link state of another interface on the routing switch. This capability is quite useful for tracking the state of the exit interface for the path for which the VRID is providing redundancy. See “Track Ports and Track Priority” on page 12-5.

USING THE CLI

To configure 1/6 on Router1 to track interface 2/4, enter the following commands:

```
Router1(config)# inter e 1/6
Router1(config-if-1/6)# ip vrrp vrid 1
Router1(config-if-1/6-vrid-1)# track-port e 2/4
```

Syntax: track-port ethernet <portnum> | ve <num>

The syntax is the same for VRRP and VRRPE.

Track Priority

When you configure a VRID to track the link state of other interfaces, if one of the tracked interface goes down, the software changes the VRRP or VRRPE priority of the VRID interface.

- For VRRP, the software changes the priority of the VRID to the track priority, which typically is lower than the VRID priority and lower than the VRID’s priorities configured on the Backups. For example, if the VRRPE interface’s priority is 100 and a tracked interface with track priority 60 goes down, the software changes the VRRPE interface’s priority to 60.
- For VRRPE, the software reduces the VRID priority by the amount of the priority of the tracked interface that went down. For example, if the VRRPE interface’s priority is 100 and a tracked interface with track priority 60

goes down, the software changes the VRRPE interface's priority to 40. If another tracked interface goes down, the software reduces the VRID's priority again, by the amount of the tracked interface's track priority.

The default track priority for a VRRP Owner is 2. The default track priority for Backups is 1.

You enter the track priority as a parameter with the **owner** or **backup** command. See "Track Port" on page 12-17.

Syntax: owner [track-priority <value>]

Syntax: backup [priority <value>] [track-priority <value>]

The syntax is the same for VRRP and VRRPE.

Backup Preempt

By default, a Backup that has a higher priority than another Backup that has become the Master can preempt the Master, and take over the role of Master. If you want to prevent this behavior, disable preemption.

Preemption applies only to Backups and takes effect only when the Master has failed and a Backup has assumed ownership of the VRID. The feature prevents a Backup with a higher priority from taking over as Master from another Backup that has a lower priority but has already become the Master of the VRID.

Preemption is especially useful for preventing flapping in situations where there are multiple Backups and a Backup with a lower priority than another Backup has assumed ownership, because the Backup with the higher priority was unavailable when ownership changed.

If you enable the non-preempt mode (thus disabling the preemption feature) on all the Backups, the Backup that becomes the Master following the disappearance of the Master continues to be the Master. The new Master is not preempted.

NOTE: In VRRP, regardless of the setting for the preempt parameter, the Owner always becomes the Master again when it comes back online.

USING THE CLI

To disable preemption on a Backup, enter commands such as the following:

```
Router1(config)# inter e 1/6
Router1(config-if-1/6)# ip vrrp vrid 1
Router1(config-if-1/6-vrid-1)# non-preempt-mode
```

Syntax: non-preempt-mode

The syntax is the same for VRRP and VRRPE.

Forcing a Master Router To Abdicate to a Standby Router

You can force a VRRP Master to abdicate (give away control) of a VRID to a Backup by temporarily changing the Master's priority to a value less than the Backup's.

The VRRP Owner always has priority 255. You can even use this feature to temporarily change the Owner's priority to a value from 1 – 254.

NOTE: When you change a VRRP Owner's priority, the change takes effect only for the current power cycle. The change is not saved to the startup-config file when you save the configuration and is not retained across a reload or reboot. Following a reload or reboot, the VRRP Owner again has priority 255.

To temporarily change the Master's priority, use the following CLI method.

USING THE CLI

To change the Master's priority, enter commands such as the following:

```
HP9300(config)# ip int eth 1/6
HP9300(config-if-1/6)# ip vrrp vrid 1
HP9300(config-if-1/6-vrid-1)# owner priority 99
```

Syntax: [no] owner priority | track-priority <num>

The <num> parameter specifies the new priority and can be a number from 1 – 254.

When you press Enter, the software changes the priority of the Master to the specified priority. If the new priority is lower than at least one Backup's priority for the same VRID, the Backup takes over and becomes the new Master until the next software reload or system reset.

To verify the change, enter the following command from any level of the CLI:

```
HP9300(config-if-1/6-vrid-1)# show ip vrrp
Total number of VRRP routers defined: 1
Interface ethernet 1/6
auth-type no authentication
VRID 1
state backup
administrative-status deactivated
mode owner
priority 99
current priority 99
hello-interval 1 sec
ip-address 192.53.5.1
backup routers 192.53.5.2
```

This example shows that even though this routing switch is the Owner of the VRID ("mode owner"), the routing switch's priority for the VRID is only 99 and the state is now "backup" instead of "active". In addition, the administrative status is now "deactivated" instead of "activated".

To change the Master's priority back to the default Owner priority 255, enter "no" followed by the command you entered to change the priority. For example, to change the priority of a VRRP Owner back to 255 from 99, enter the following command:

```
HP9300(config-if-1/6-vrid-1)# no owner priority 99
```

You cannot set the priority to 255 using the **owner priority** command.

USING THE WEB MANAGEMENT INTERFACE

You cannot change the Master router's priority using the Web management interface.

Displaying VRRP and VRRPE Information

You can display the following information for VRRP or VRRPE:

- Summary configuration and status information
- Detailed configuration and status information
- Statistics

NOTE: You cannot display VRRPE information using the Web management interface.

Displaying Summary Information

To display summary VRRP or VRRPE information, use the following CLI method.

USING THE CLI

To display summary information for a routing switch, enter the following command at any level of the CLI:

```
HP9300(config-if-e1000-1/6-vrid-1)# show ip vrrp brief

Total number of VRRP routers defined: 1
Interface VRID CurPri P State  Master addr   Backup addr       VIP
 1/6        1    255  P Init   192.53.5.1    192.53.5.3 192.53.5.1
```

This example is for VRRP. Here is an example for VRRPE:

```
HP9300(config-if-e1000-1/6-vrid-1)# show ip vrrp-extended brief

Total number of VRRP-Extended routers defined: 1
Interface VRID CurPri P State  Master addr   Backup addr       VIP
 1/6        1    255  P Init   192.53.5.2    192.53.5.3 192.53.5.254
```

Syntax: show ip vrrp brief | ethernet <portnum> | ve <num> | stat

Syntax: show ip vrrp-extended brief | ethernet <portnum> | ve <num> | stat

The **brief** parameter displays the summary information. If you do not use this parameter, detailed information is displayed instead. See “Displaying Detailed Information” on page 12-21.

The **ethernet** <portnum> parameter specifies an Ethernet port. If you use this parameter, the command displays VRRP or VRRPE information only for the specified port.

The **ve** <num> parameter specifies a virtual interface. If you use this parameter, the command displays VRRP or VRRPE information only for the specified virtual interface.

The **stat** parameter displays statistics. See “Displaying Statistics” on page 12-26.

This display shows the following information.

Table 12.2: CLI Display of VRRP or VRRPE Summary Information

This Field...	Displays...
Total number of VRRP (or VRRP-Extended) routers defined	The total number of VRIDs configured on this routing switch. **Note**: The total applies only to the protocol the routing switch is running. For example, if the routing switch is running VRRPE, the total applies only to VRRPE routers.
Interface	The interface on which VRRP or VRRPE is configured. If VRRP or VRRPE is configured on multiple interfaces, information for each interface is listed separately.
VRID	The VRID configured on this interface. If multiple VRIDs are configured on the interface, information for each VRID is listed in a separate row.
CurPri	The current VRRP or VRRPE priority of this routing switch for the VRID.
P	Whether the backup preempt mode is enabled. If the backup preempt mode is enabled, this field contains a “P”. If the mode is disabled, this field is blank.
State	This routing switch’s VRRP or VRRPE state for the VRID. The state can be one of the following: • Init – The VRID is not enabled (activated). If the state remains Init after you activate the VRID, make sure that the VRID is also configured on the other routers and that the routers can communicate with each other. **Note**: If the state is Init and the mode is incomplete, make sure you have specified the IP address for the VRID. • Backup – This routing switch is a Backup for the VRID. • Master – This routing switch is the Master for the VRID.

Table 12.2: CLI Display of VRRP or VRRPE Summary Information (Continued)

This Field...	Displays...
Master addr	The IP address of the router interface that is currently the Master for the VRID.
Backup addr	The IP addresses of the router interfaces that are currently Backups for the VRID.
VIP	The virtual IP address that is being backed up by the VRID.

USING THE WEB MANAGEMENT INTERFACE

You cannot display the summary view using the Web management interface. Use the Web management procedure in “Displaying Detailed Information”.

Displaying Detailed Information

To display detailed VRRP or VRRPE information, use either of the following methods.

USING THE CLI

To display detailed information for a routing switch, enter the following command at any level of the CLI:

```
HP9300(config)# show ip vrrp

Total number of VRRP routers defined: 1
Interface ethernet 1/6
 auth-type no authentication
 VRID 1
  state master
  administrative-status enabled
  mode owner
  priority 255
  current priority 255
  hello-interval 1 sec
  advertise backup: disabled
  track-port 2/4
```

This example is for a VRRP Owner. Here is an example for a VRRP Backup.

```
HP9300(config)# show ip vrrp

Total number of VRRP routers defined: 1
Interface ethernet 1/5
 auth-type no authentication
 VRID 1
  state backup
  administrative-status enabled
  mode non-owner(backup)
  priority 100
  current priority 100
  hello-interval 1 sec
  dead-interval 3.600 sec
  current dead-interval 3.600 sec
  preempt-mode true
  advertise backup: enabled
  backup router 192.53.5.3 expires in 00:00:03
  next hello sent in 00:00:02
  track-port 3/2
```

Here is an example for a VRRPE Backup.

```
HP9300(config)# show ip vrrp-extended

Total number of VRRP-Extended routers defined: 1
Interface ethernet 1/6
 auth-type no authentication
 VRID 1
  state master
  administrative-status enabled
  priority 200
  current priority 200
  hello-interval 1 sec
  dead-interval 3.600 sec
  current dead-interval 3.600 sec
  preempt-mode true
  virtual ip address 192.53.5.254
  advertise backup: enabled
  master router 192.53.5.2 expires in 00:00:03
  track-port 2/4
```

Syntax: show ip vrrp brief | ethernet <portnum> | ve <num> | stat

Syntax: show ip vrrp-extended brief | ethernet <portnum> | ve <num> | stat

The **brief** parameter displays summary information. See “Displaying Summary Information” on page 12-19.

The **ethernet** <portnum> parameter specifies an Ethernet port. If you use this parameter, the command displays VRRP or VRRPE information only for the specified port.

The **ve** <num> parameter specifies a virtual interface. If you use this parameter, the command displays VRRP or VRRPE information only for the specified virtual interface.

The **stat** parameter displays statistics. See “Displaying Statistics” on page 12-26.

This display shows the following information.

Table 12.3: CLI Display of VRRP or VRRPE Detailed Information

This Field...	Displays...
Total number of VRRP (or VRRP-Extended) routers defined	The total number of VRIDs configured on this routing switch. **Note**: The total applies only to the protocol the routing switch is running. For example, if the routing switch is running VRRPE, the total applies only to VRRPE routers.
Interface parameters	
Interface	The interface on which VRRP or VRRPE is configured. If VRRP or VRRPE is configured on multiple interfaces, information for each interface is listed separately.
auth-type	The authentication type enabled on the interface.
VRID parameters	
VRID	The VRID configured on this interface. If multiple VRIDs are configured on the interface, information for each VRID is listed separately.

Table 12.3: CLI Display of VRRP or VRRPE Detailed Information (Continued)

This Field...	Displays...
state	This routing switch's VRRP or VRRPE state for the VRID. The state can be one of the following: • initialize – The VRID is not enabled (activated). If the state remains "initialize" after you activate the VRID, make sure that the VRID is also configured on the other routers and that the routers can communicate with each other. **Note**: If the state is "initialize" and the mode is incomplete, make sure you have specified the IP address for the VRID. • backup – This routing switch is a Backup for the VRID. • master – This routing switch is the Master for the VRID.
administrative-status	The administrative status of the VRID. The administrative status can be one of the following: • disabled – The VRID is configured on the interface but VRRP or VRRPE has not been activated on the interface. • enabled – VRRP or VRRPE has been activated on the interface.
mode	Indicates whether the routing switch is the Owner or a Backup for the VRID. **Note**: If "incomplete" appears after the mode, configuration for this VRID is incomplete. For example, you might not have configured the virtual IP address that is being backup up by the VRID. **Note**: This field applies only to VRRP. All routing switches configured for VRRPE are Backups.
priority	The device's preferability for becoming the Master for the VRID. During negotiation, the router with the highest priority becomes the Master. If two or more devices are tied with the highest priority, the Backup interface with the highest IP address becomes the active router for the VRID.
current priority	The current VRRP or VRRPE priority of this routing switch for the VRID. The current priority can differ from the configured priority (see the row above) for the following reasons: • The VRID is still in the initialization stage and has not become a Master or Backup yet. In this case, the current priority is 0. • The VRID is configured with track ports and the link on a tracked interface has gone down. See "Track Ports and Track Priority" on page 12-5.
hello-interval	The number of seconds between Hello messages from the Master to the Backups for a given VRID.

Table 12.3: CLI Display of VRRP or VRRPE Detailed Information (Continued)

This Field...	Displays...
dead-interval	The configured value for the dead interval. The dead interval is the number of seconds a Backup waits for a Hello message from the Master for the VRID before determining that the Master is no longer active. If the Master does not send a Hello message before the dead interval expires, the Backups negotiate (compare priorities) to select a new Master for the VRID. **Note**: If the value is 0, then you have not configured this parameter. **Note**: This field does not apply to VRRP Owners.
current dead-interval	The current value of the dead interval. This is the value actually in use by this interface for the VRID. **Note**: This field does not apply to VRRP Owners.
preempt-mode	Whether the backup preempt mode is enabled. **Note**: This field does not apply to VRRP Owners.
virtual ip address	The virtual IP addresses that this VRID is backing up.
advertise backup	The IP addresses of Backups that have advertised themselves to this routing switch by sending Hello messages. **Note**: Hello messages from Backups are disabled by default. You must enable the Hello messages on the Backup for the Backup to advertise itself to the current Master. See "Hello Messages" on page 12-4.
backup router <ip-addr> expires in <time>	The IP addresses of Backups that have advertised themselves to this Master by sending Hello messages. The <time> value indicates how long before the Backup expires. A Backup expires if you disable the advertise backup option on the Backup or the Backup becomes unavailable. Otherwise, the Backup's next Hello message arrives before the Backup expires. The Hello message resets the expiration timer. An expired Backup does not necessarily affect the Master. However, if you have not disabled the advertise backup option on the Backup, then the expiration may indicate a problem with the Backup. **Note**: This field applies only when Hello messages are enabled on the Backups (using the advertise backup option).
next hello sent in <time>	How long until the Backup sends its next Hello message. **Note**: This field applies only when this routing switch is the Master and the Backup is configured to send Hello messages (the advertise backup option is enabled).
master router <ip-addr> expires in <time>	The IP address of the Master and the amount of time until the Master's dead interval expires. If the Backup does not receive a Hello message from the Master by the time the interval expires, either the IP address listed for the Master will change to the IP address of the new Master, or this routing switch itself will become the Master. **Note**: This field applies only when this routing switch is a Backup.

Table 12.3: CLI Display of VRRP or VRRPE Detailed Information (Continued)

This Field...	Displays...
track port	The interfaces that the VRID's interface is tracking. If the link for a tracked interface goes down, the VRRP or VRRPE priority of the VRID interface is changed, causing the devices to renegotiate for Master. **Note**: This field is displayed only if track interfaces are configured for this VRID.

USING THE WEB MANAGEMENT INTERFACE

NOTE: This procedure applies only to VRRP. You cannot display VRRPE information using the Web management interface.

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Monitor in the tree view to display the monitoring options.
3. Click on the plus sign next to VRRP in the tree view to expand the list of VRRP option links.
4. Click on the Interface link to display the virtual router table.
5. Click on the Virtual Router link to display the virtual router table.

NOTE: If a parameter is not defined or does not apply to this type of entry, the field is blank. For example, if the entry is for a VRRP Owner, the Backup Priority field does not apply and is blank.

This display shows the following information.

Table 12.4: Web Display of VRRP Detailed Information

This Field...	Displays...
Interface table	
Port	The interface number. All the device's interfaces are listed.
Authentication Type	The authentication type enabled on the interface.
Simple Text Password	If the authentication type is simple password, this field lists the password.
Virtual Router table	
Port	The interface number. All the device's interfaces are listed.
ID	The VRID configured on this interface. If multiple VRIDs are configured on the interface, information for each VRID is listed separately.
Hello Intv	The number of seconds between Hello messages from the Master to the Backups for a given VRID.
Activate	Indicates whether this VRID is activated. After configuring the VRID, you must activate it. The VRID is disabled by default.
IP List	The IP addresses that this VRID is backing up.

Table 12.4: Web Display of VRRP Detailed Information (Continued)

This Field...	Displays...
Mode	Indicates whether the routing switch is the Owner or a Backup for the VRID. **Note**: The mode applies only to VRRP. All routing switches configured for VRRPE are Backups.
Backup – Priority	The device's preferability for becoming the Master for the VRID. During negotiation, the router with the highest priority becomes the Master. If two or more devices are tied with the highest priority, the Backup interface with the highest IP address becomes the active router for the VRID.
Backup – Dead Intv	The number of seconds a Backup waits for a Hello message from the Master for the VRID before determining that the Master is no longer active. If the Master does not send a Hello message before the dead interval expires, the Backups negotiate (compare priorities) to select a new Master for the VRID.
Backup – Preempt	The state of the Backup preempt mode. The Backup preempt mode prevents a Backup with a higher VRRP priority from taking control of the VRID from another Backup that has a lower priority but has already assumed control of the VRID.
Track – Priority	A VRRP priority value assigned to the tracked port(s). If a tracked port's link goes down, the VRID port's priority is reduced by the amount of the tracked port's priority.
Track – Vif List	The virtual interfaces that the VRID's interface is tracking. If the link for a tracked interface goes down, the VRRP priority of the VRID interface is changed, causing the devices to renegotiate for Master.
Track – Port List	The physical ports that the VRID's interface is tracking. If the link for a tracked port goes down, the VRRP priority of the VRID interface is changed, causing the devices to renegotiate for Master.

Displaying Statistics

To display VRRP or VRRPE statistics, use either of the following methods.

USING THE CLI

To display statistics, enter a command such as the following at any level of the CLI:

```
HP9300(config-if-e1000-1/5-vrid-1)# show ip vrrp stat

Interface ethernet 1/5
 rxed vrrp header error count = 0
 rxed vrrp auth error count = 0
 rxed vrrp auth passwd mismatch error count = 0
 rxed vrrp vrid not found error count = 0
 VRID 1
 rxed arp packet drop count = 0
 rxed ip packet drop count = 0
```

```
rxed vrrp port mismatch count = 0
rxed vrrp ip address mismatch count = 0
rxed vrrp hello interval mismatch count = 0
rxed vrrp priority zero from master count = 0
rxed vrrp higher priority count = 0
transitioned to master state count = 1
transitioned to backup state count = 1
```

The same statistics are listed for VRRP and VRRPE.

Syntax: show ip vrrp brief | ethernet <portnum> | ve <num> | stat

Syntax: show ip vrrp-extended brief | ethernet <portnum> | ve <num> | stat

The **brief** parameter displays summary information. See “Displaying Summary Information” on page 12-19.

The **ethernet** <portnum> parameter specifies an Ethernet port. If you use this parameter, the command displays detailed VRRP or VRRPE information only for the specified port. See “Displaying Detailed Information” on page 12-21.

The **ve** <num> parameter specifies a virtual interface. If you use this parameter, the command displays detailed VRRP or VRRPE information only for the specified virtual interface. See “Displaying Detailed Information” on page 12-21.

The **stat** parameter displays statistics. This parameter is required for displaying the statistics.

This display shows the following information.

Table 12.5: CLI Display of VRRP or VRRPE Statistics

This Field...	Displays...
Interface Statistics	
Interface	The interface on which VRRP or VRRPE is configured. If VRRP or VRRPE is configured on more than one interface, the display lists the statistics separately for each interface.
rxed vrrp header error count	The number of VRRP or VRRPE packets received by the interface that had a header error.
rxed vrrp auth error count	The number of VRRP or VRRPE packets received by the interface that had an authentication error.
rxed vrrp auth passwd mismatch error count	The number of VRRP or VRRPE packets received by the interface that had a password value that does not match the password used by the interface for authentication.
rxed vrrp vrid not found error count	The number of VRRP or VRRPE packets received by the interface that contained a VRID that is not configured on this interface.
VRID Statistics	
rxed arp packet drop count	The number of ARP packets addressed to the VRID that were dropped.
rxed ip packet drop count	The number of IP packets addressed to the VRID that were dropped.
rxed vrrp port mismatch count	The number of packets received that did not match the configuration for the receiving interface.
rxed vrrp ip address mismatch count	The number of packets received that did not match the configured IP addresses.

Table 12.5: CLI Display of VRRP or VRRPE Statistics (Continued)

This Field...	Displays...
rxed vrrp hello interval mismatch count	The number of packets received that did not match the configured Hello interval.
rxed vrrp priority zero from master count	The current Master has resigned.
rxed vrrp higher priority count	The number of VRRP or VRRPE packets received by the interface that had a higher backup priority for the VRID than this routing switch's backup priority for the VRID.
transitioned to master state count	The number of times this routing switch has changed from the backup state to the master state for the VRID.
transitioned to backup state count	The number of times this routing switch has changed from the master state to the backup state for the VRID.

USING THE WEB MANAGEMENT INTERFACE

NOTE: This procedure applies only to VRRP. You cannot display VRRPE information using the Web management interface.

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Monitor in the tree view to display the monitoring options.
3. Click on the plus sign next to VRRP in the tree view to expand the list of VRRP option links.
4. Click on the Virtual Router link to display the virtual router table or the Interface link to display the VRRP Interface table. The VRRP Interface table shows a row for each interface on the routing switch.

NOTE: If a parameter is not defined or does not apply to this type of entry, the field is blank. For example, if the entry is for a VRRP Owner, the Backup Priority field does not apply and is blank.

NOTE: It is possible for the statistics display for a Backup to show "Master" in the state field even when you have not yet configured another VRRP or VRRPE router. When you activate a Backup, if the Backup's Dead interval expires before the Backup hears from another VRRP or VRRPE router, the Backup becomes the Master.

This display shows the following information.

Table 12.6: Web Display of VRRP Statistics

This Field...	Displays...
Virtual Router panel	
Port	The interface on which VRRP is configured. If VRRP is configured on more than one interface, the display lists the statistics separately for each interface.
Header Error	The number of VRRP packets received by the interface that had a header error.
Authen Type Error	The number of VRRP packets received by the interface that had an authentication error.

Table 12.6: Web Display of VRRP Statistics (Continued)

This Field...	Displays...
Authen Password Mismatch Error	The number of VRRP packets received by the interface that had a password value that does not match the password used by the interface for authentication.
Virtual Router ID Error	The number of VRRP packets received by the interface that contained a VRID that is not configured on this interface.
Interface Statistics panel	
Port	The interface on which VRRP is configured. If VRRP is configured on more than one interface, the display lists the statistics separately for each interface.
ID	The VRID.
State	This routing switch's VRRP state for the VRID. The state can be one of the following: • Init – The VRID is not enabled (activated). If the state remains Init after you activate the VRID, make sure that the VRID is also configured on the other routers and that the routers can communicate with each other. **Note**: If the state is Init and the mode is incomplete, make sure you have specified the IP address for the VRID. • Backup – This routing switch is a Backup for the VRID. • Master – This routing switch is the Master for the VRID.
Receive Pkts Drop – ARP	The number of ARP packets addressed to the VRID that were dropped.
Receive Pkts Drop – IP	The number of IP packets addressed to the VRID that were dropped.
Receive Mismatch – Port	The number of packets received that did not match the configuration for the receiving interface.
Receive Mismatch – Num of IP	The number of packets received that did not match the configured IP addresses.
Receive Mismatch – IP	The number of packets received that did not match the configured Hello interval.
Receive Mismatch – Hello	The current Master has resigned.
Rcv Priority Zero from Master	The number of packets received that did not match the configuration for the receiving interface.
Rcv Higher Priority	The number of VRRP packets received by the interface that had a higher backup priority for the VRID than this routing switch's backup priority for the VRID.
Transmit Count – Master	The number of times this routing switch has changed from the backup state to the master state for the VRID.
Transmit Count – Backup	The number of times this routing switch has changed from the master state to the backup state for the VRID.

Clearing VRRP or VRRPE Statistics

Use the following methods to clear VRRP or VRRPE statistics.

USING THE CLI

To clear VRRP or VRRPE statistics, enter the following command at the Privileged EXEC level or any configuration level of the CLI:

```
Router1(config)# clear ip vrrp-stat
```

Syntax: clear ip vrrp-stat

USING THE WEB MANAGEMENT INTERFACE

NOTE: This procedure applies only to VRRP. You cannot display VRRPE information using the Web management interface.

---

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Command in the tree view to expand the list of command options.
3. Click on the Clear link to display the Clear panel.
4. Select VRRP.
5. Click the Apply button to implement the change.

Configuration Examples

The following sections contain the CLI commands and Web management options for implementing the VRRP and VRRPE configurations shown in Figure 12.2 on page 12-3 and Figure 12.3 on page 12-7.

NOTE: The Web management example applies only to VRRP. You cannot configure VRRPE using the Web management interface.

VRRP Example

To implement the VRRP configuration shown in Figure 12.2 on page 12-3, use either of the following methods.

USING THE CLI

Configuring Router1 Using the CLI

To configure VRRP Router1, enter the following commands:

```
Router1(config)# router vrrp
Router1(config)# inter e 1/6
Router1(config-if-1/6)# ip address 192.53.5.1
Router1(config-if-1/6)# ip vrrp vrid 1
Router1(config-if-1/6-vrid-1)# owner track-priority 20
Router1(config-if-1/6-vrid-1)# track-port ethernet 2/4
Router1(config-if-1/6-vrid-1)# ip-address 192.53.5.1
Router1(config-if-1/6-vrid-1)# activate
```

NOTE: When you configure the Master (Owner), the address you enter with the **ip-address** command must already be configured on the interface.

The **ip vrrp owner** command specifies that this router owns the IP address you are associating with the VRID. Because this router owns the IP address, this router is the default Master router and its VRRP priority is thus 255.

Configuring Router2 Using the CLI

To configure Router2 in Figure 12.2 on page 12-3 after enabling VRRP, enter the following commands:

```
Router2(config)# router vrrp
Router2(config)# inter e 1/5
Router2(config-if-1/5)# ip address 192.53.5.3
Router2(config-if-1/5)# ip vrrp vrid 1
Router2(config-if-1/5-vrid-1)# backup priority 100 track-priority 19
Router2(config-if-1/5-vrid-1)# track-port ethernet 3/2
Router2(config-if-1/5-vrid-1)# ip-address 192.53.5.1
Router2(config-if-1/5-vrid-1)# activate
```

The **backup** command specifies that this router is a VRRP Backup for virtual router VRID1. The IP address entered with the **ip-address** command is the same IP address as the one entered when configuring Router1. In this case, the IP address cannot also exist on Router2, but the interface on which you are configuring the VRID Backup must have an IP address in the same sub-net. By entering the same IP address as the one associated with this VRID on the Owner, you are configuring the Backup to back up the address, but you are not duplicating the address.

NOTE: When you configure a Backup router, the router interface on which you are configuring the VRID must have a real IP address that is in the same sub-net as the address associated with the VRID by the Owner. However, the address cannot be the same.

The **priority** parameter establishes the router's VRRP priority in relation to the other VRRP router(s) in this virtual router. The **track-priority** parameter specifies the new VRRP priority that the router receives for this VRID if the interface goes down. See "Track Ports and Track Priority" on page 12-5.

The **activate** command activates the VRID configuration on this interface. The interface does not provide backup service for the virtual IP address until you activate the VRRP configuration.

Syntax: router vrrp

Syntax: ip vrrp vrid <vrid>

Syntax: owner [track-priority <value>]

Syntax: backup [priority <value>] [track-priority <value>]

Syntax: track-port ethernet <portnum> | ve <num>

Syntax: ip-address <ip-addr>

Syntax: activate

USING THE WEB MANAGEMENT INTERFACE

Use the following procedures to create a virtual router using the Web management interface.

NOTE: Some of the data entry fields contain zeros. When you save a VRRP definition, the software uses the default values for the parameters instead of zeros. The Web management interface shows zeros instead of the defaults because the defaults differ depending on whether you are creating an Owner or a Backup. The software does not know which type of VRID entry you are creating until you select Add to add the entry.

Configuring Router1 Using the Web Management Interface

To configure VRRP Router1 in Figure 12.2 on page 12-3 after you enable VRRP:

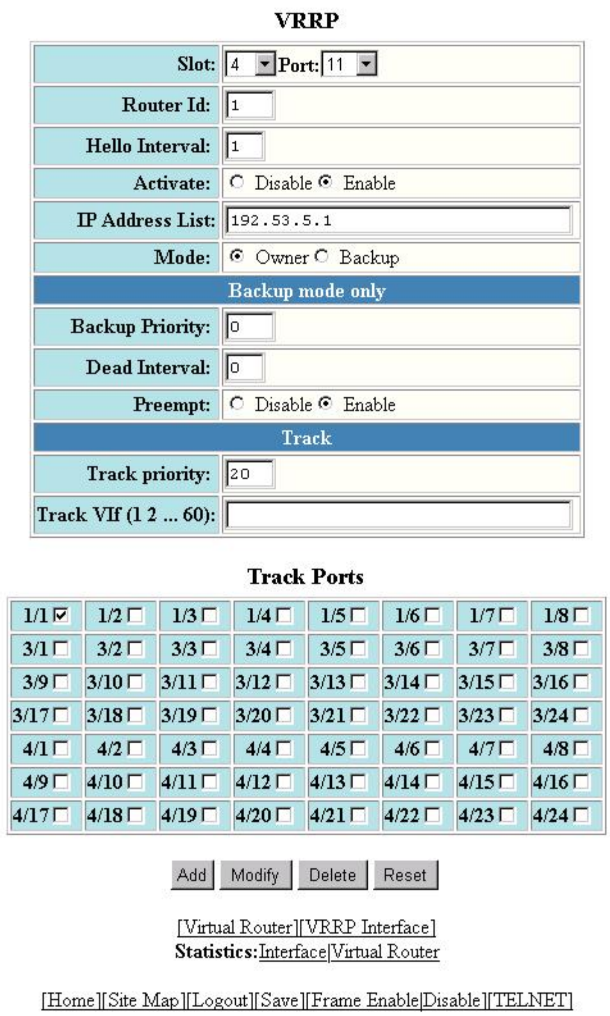
1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.

2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.

3. Click on the plus sign next to VRRP in the tree view to expand the list of VRRP option links.

4. Click on the <u>Virtual Router</u> link.

- If the device does not have a VRRP virtual router configured, the VRRP configuration panel is displayed, as shown in the following example.
- If a VRRP virtual router is already configured and you are adding a new one, click on the Add Virtual Router link to display the VRRP configuration panel, as shown in the following example.
- If you are modifying an existing VRRP virtual router, click on the Modify button to the right of the row describing the VRRP virtual router to display the VRRP configuration panel, as shown in the following example.



5. Select the interface from the pulldown list on the Port field. In this example, select 1/6.
6. Enter the VRID in the Router ID field the Router ID field. In this example, use the default value, 1.
7. Enter the Hello interval or leave the field unchanged to use the default. The software fills in the default after you select Add. In this example, leave the field unchanged.
8. Select Enable to activate the VRRP entry after you select Add.
9. Enter the interface's IP address in the IP Address List field. In this example, enter 192.53.5.1.
10. Select the mode (Owner or Backup). Select Owner in this example.
11. Enter the track priority or leave the field blank to use the default. In this example, enter 20.

12. Enter or select the track interface or port:
    - If you want to use a virtual interface as a track port, enter the virtual interface name.
    - If you want to use a physical interface as a track port, select the port. In this example, select 2/4.
13. Click the Add button to apply the changes to the device's running-config.
14. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring Router2 Using the Web Management Interface

To configure VRRP Router2 in Figure 12.2 on page 12-3 after you enable VRRP:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to VRRP in the tree view to expand the list of VRRP option links.
4. Click on the Virtual Router link.
    - If the device does not have a VRRP virtual router configured, the VRRP configuration panel is displayed.
    - If a VRRP virtual router is already configured and you are adding a new one, click on the Add Virtual Router link to display the VRRP configuration panel.
    - If you are modifying an existing VRRP virtual router, click on the Modify button to the right of the row describing the VRRP virtual router to display the VRRP configuration panel.
5. Select the interface from the pulldown list on the Port field. In this example, select 1/5.
6. Enter the VRID in the Router ID field the Router ID field. In this example, use the default value 1.
7. Enter the Hello interval or leave the field as is to use the default. The software fills in the default after you select Add. In this example, leave the field unchanged.
8. Select Enable to activate the VRRP entry after you select Add.
9. Enter the interface's IP address in the IP Address List field. In this example, enter 192.53.5.1. By entering the same IP address as the one associated with this VRID on the Owner, you configure the Backup to back up the address, but you are not duplicating the address.

NOTE: When you configure a Backup router, the router interface on which you are configuring the VRID must have a real IP address that is in the same sub-net as the address associated with the VRID by the Owner. However, the address cannot be the same.

10. Select the mode (Owner or Backup). Select Backup in this example.
11. Enter the backup priority or leave the value unchanged. In this example, enter 100.

NOTE: This is the default for Backups. You also can leave the field unchanged, and the software will automatically assign 100 as the priority when you select Add.

12. Enter the Dead interval or leave the field unchanged to use the default value.
13. Enable preempt mode if desired. In this example, leave preempt mode disabled.
14. Enter the track priority or leave the field blank to use the default. In this example, enter 19.
15. Enter or select the track interface or port:
    - If you want to use a virtual interface as a track port, enter the virtual interface name.
    - If you want to use a physical interface as a track port, select the port. In this example, select 3/2.
16. Click the Add button to apply the changes to the device's running-config.

17. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

VRRPE Example

To implement the VRRPE configuration shown in Figure 12.3 on page 12-7, use the following CLI method.

Configuring Router1 Using the CLI

To configure VRRP Router1 in Figure 12.3 on page 12-7, enter the following commands:

```
Router1(config)# router vrrp-extended
Router1(config)# inter e 1/6
Router1(config-if-1/6)# ip address 192.53.5.2
Router1(config-if-1/6)# ip vrrp-extended vrid 1
Router1(config-if-1/6-vrid-1)# backup priority 200 track-priority 20
Router1(config-if-1/6-vrid-1)# track-port ethernet 2/4
Router1(config-if-1/6-vrid-1)# ip-address 192.53.5.254
Router1(config-if-1/6-vrid-1)# activate
```

NOTE: The address you enter with the **ip-address** command cannot be the same as a real IP address configured on the interface.

Configuring Router2 Using the CLI

To configure Router2, enter the following commands:

```
Router2(config)# router vrrp-extended
Router2(config)# inter e 1/5
Router2(config-if-1/5)# ip address 192.53.5.3
Router2(config-if-1/5)# ip vrrp-extended vrid 1
Router2(config-if-1/5-vrid-1)# backup priority 100 track-priority 19
Router2(config-if-1/5-vrid-1)# track-port ethernet 3/2
Router2(config-if-1/5-vrid-1)# ip-address 192.53.5.254
Router2(config-if-1/5-vrid-1)# activate
```

The **backup** command specifies that this router is a VRRPE Backup for virtual router VRID1. The IP address entered with the **ip-address** command is the same IP address as the one entered when configuring Router1. In this case, the IP address cannot also exist on Router2, but the interface on which you are configuring the VRID Backup must have an IP address in the same sub-net. By entering the same IP address as the one associated with this VRID on the Owner, you are configuring the Backup to back up the address, but you are not duplicating the address.

NOTE: When you configure a Backup router, the router interface on which you are configuring the VRID must have a real IP address that is in the same sub-net as the address associated with the VRID by the Owner. However, the address cannot be the same.

The **priority** parameter establishes the router's VRRPE priority in relation to the other VRRPE router(s) in this virtual router. The **track-priority** parameter specifies the new VRRPE priority that the router receives for this VRID if the interface goes down. See "Track Ports and Track Priority" on page 12-5.

The **activate** command activates the VRID configuration on this interface. The interface does not provide backup service for the virtual IP address until you activate the VRRPE configuration. Alternatively, you can use the **enable** command. The **activate** and **enable** commands do the same thing.

Syntax: router vrrp-extended

Syntax: ip vrrp-extended vrid <vrid>

Syntax: backup [priority <value>] [track-priority <value>]

Syntax: track-port ethernet <portnum> | ve <num>

Syntax: ip-address <ip-addr>

Syntax: activate

USING THE WEB MANAGEMENT INTERFACE

You cannot configure VRRPE using the Web management interface.

Chapter 13
Configuring SRP

This chapter describes how to configure the HP 9304M, HP 9308M, and HP 6308M-SX routing switches to use the Standby Router Protocol (SRP), a proprietary protocol that provides redundant paths between two routing switches.

Details for configuring SRP with the CLI and the Web management interface are shown. For detailed summaries of all CLI commands, including the syntax and ranges of parameter values, see the *Command Line Interface Reference*.

For information about the differences between SRP and the Virtual Router Redundancy Protocol (VRRP), see "Differences Between SRP and VRRP" on page 13-7.

Overview of Standby Router Protocol (SRP)

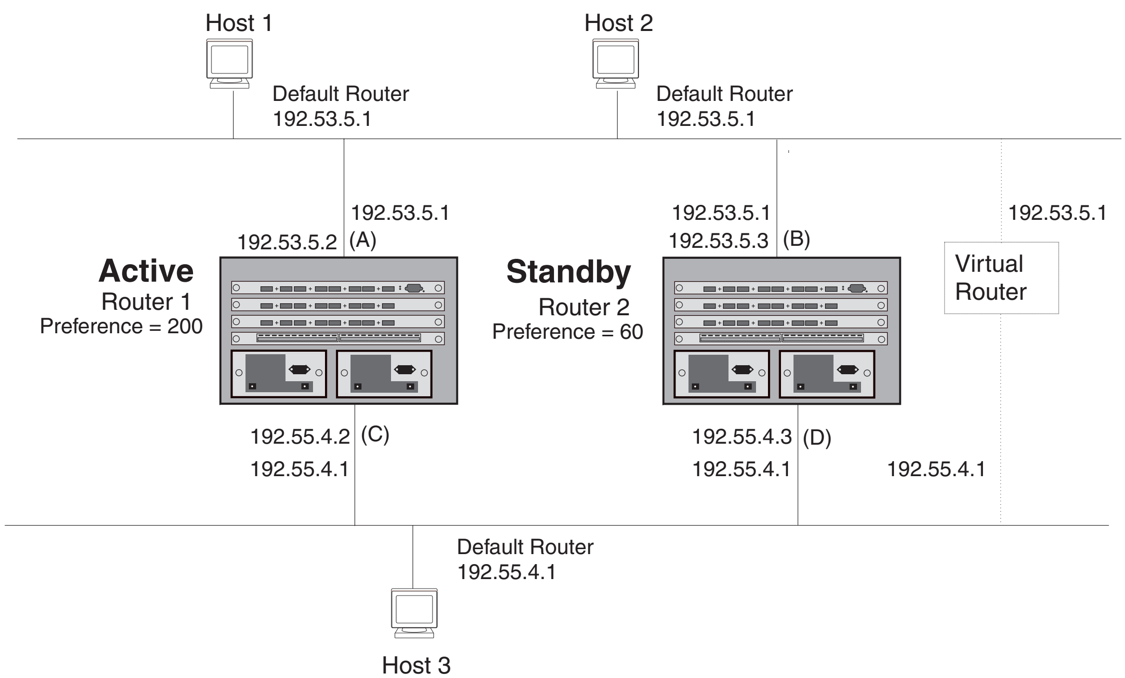
SRP allows alternate paths to be provided to a host. To provide path redundancy between given hosts, a ***virtual router*** with its own unique IP addresses is created. The virtual router is created by assigning these unique IP addresses to ports on existing routing switches in the network—routing switches that could provide a path between the given hosts.

NOTE: Virtual IP router addresses are in addition to the IP address assigned to each IP interface.

For example, in Figure 13.1, suppose you want to provide continual connectivity between Host 1 and Host 3 with the use of redundant paths. A virtual router is created by assigning the same virtual router IP address to all physical interfaces that will provide redundant paths for that portion of the network. Virtual router IP address 192.53.5.1 is assigned to interfaces A and B, and the virtual router IP address 192.55.4.1 is assigned to interfaces C and D. Notice that in both cases, these virtual addresses are in addition to their physical IP addresses.

The virtual IP address also serves as the default router for the hosts. Hosts 1 and 2 reference the virtual IP router address 192.53.5.1 as their default router and Host 3 references the virtual router IP address, 192.55.4.1.

If Router 1 goes down, then Router 2 provides connectivity between Host 1 and Host 3.



Router 1:
IP Address for Interface A: 192.53.5.2
Virtual Router IP address for Interface A: 192.53.5.1
IP Address for Interface C: 192.55.4.2
Virtual Router IP address for Interface C: 192.55.4.1

Router 2:
IP Address for Interface B: 192.53.5.3
Virtual Router IP address for Interface B: 192.53.5.1
IP Address for Interface D: 192.55.4.3
Virtual Router IP address for Interface D: 192.55.4.1

Figure 13.1 SRP operating in an HP 9304M network

SRP Support on Virtual Interfaces

SRP is supported on both physical and virtual interfaces. Support on a virtual interface allows you to assign a single virtual interface to serve as a redundant link for multiple ports within a VLAN. For example, in Figure 13.2, virtual interface 1 represents ports 1, 2, and 3 for Router 1.

A virtual interface will by default remain active until all underlying links go down. If you want the virtual link to go to SRP standby state when a subset of the ports goes down, you must configure track ports as well.

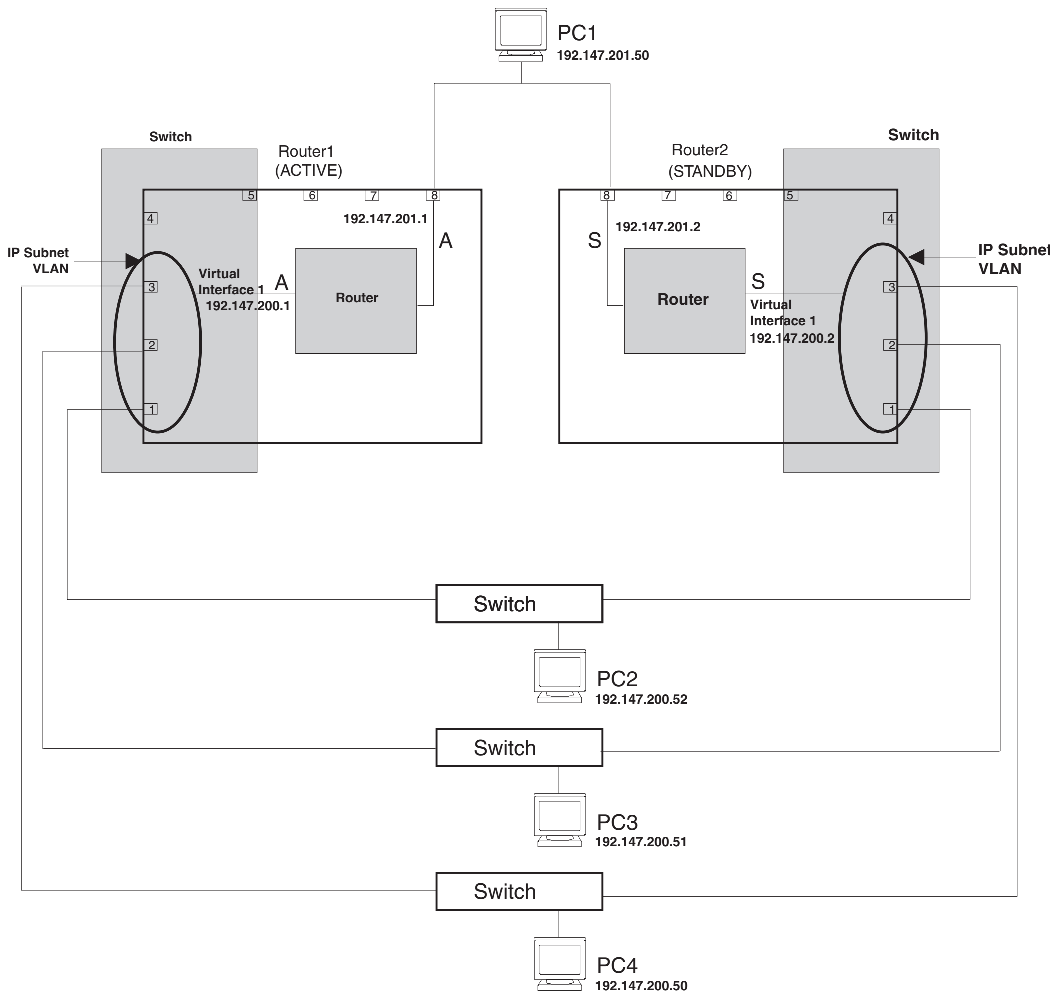


Figure 13.2 Virtual interface as a redundant link

Active and Standby Routers

To establish one routing switch as active, you assign a higher preference to the routing switch. If the preference for two routing switches is equal, the interface with the higher IP address takes precedence as the active router. Link status is monitored using a track port.

Track Ports

A ***track port*** tracks the status of the ports that are providing redundant paths. You can assign any port to be a track port; however, a port that is providing a redundant path cannot serve as its own track port. A track port should be assigned to track each port that is part of a virtual link. For example, in Figure 13.1, interfaces A, B, C, and D should all be assigned track ports.

If a change in state (up or down) is detected by the track port, the priority of the SRP Group Interface will automatically be increased or decreased.

NOTE: Virtual router interfaces cannot be assigned as track ports.

Multiple Track Port Support

You can assign multiple ports to serve as track ports for SRP redundant links. If an active link fails, all SRP interfaces that serve as track ports for the failed link are placed in standby mode.

This feature allows you to configure a system so that a given routing switch and its defined redundant links will be in either active or standby mode. Multiple track port assignment prevents a mix of active and standby links to exist on a routing switch.

For example, in Figure 13.3, links on Router 1 designated as e1 and e3 have failed and have transferred control to their standby links on Router 2; e4 and e2 remain as active links. This results in Router 1, the routing switch that was originally assigned to serve as the active router, having a mix of active and standby links.

To bias all traffic and link traffic to the standby router, assign all other redundant links as track ports for all other interfaces on the routing switch. For example, on Router 1, you would assign interfaces e1, e2, and e3 as track ports for e4. Interfaces e1, e2, and e4 would thus track port e3. Interfaces e2, e3, and, e4 would track port e1. Interfaces e1, e3, and e4 would track port e2. Configured in this manner, a failure on Router 1 links e1 and e3 would make Router 2 the active router for all the links seen in Figure 13.4.

Because one routing switch and all its links are active and the other routing switch and its links are all in standby mode, all traffic will be directed to the active router.

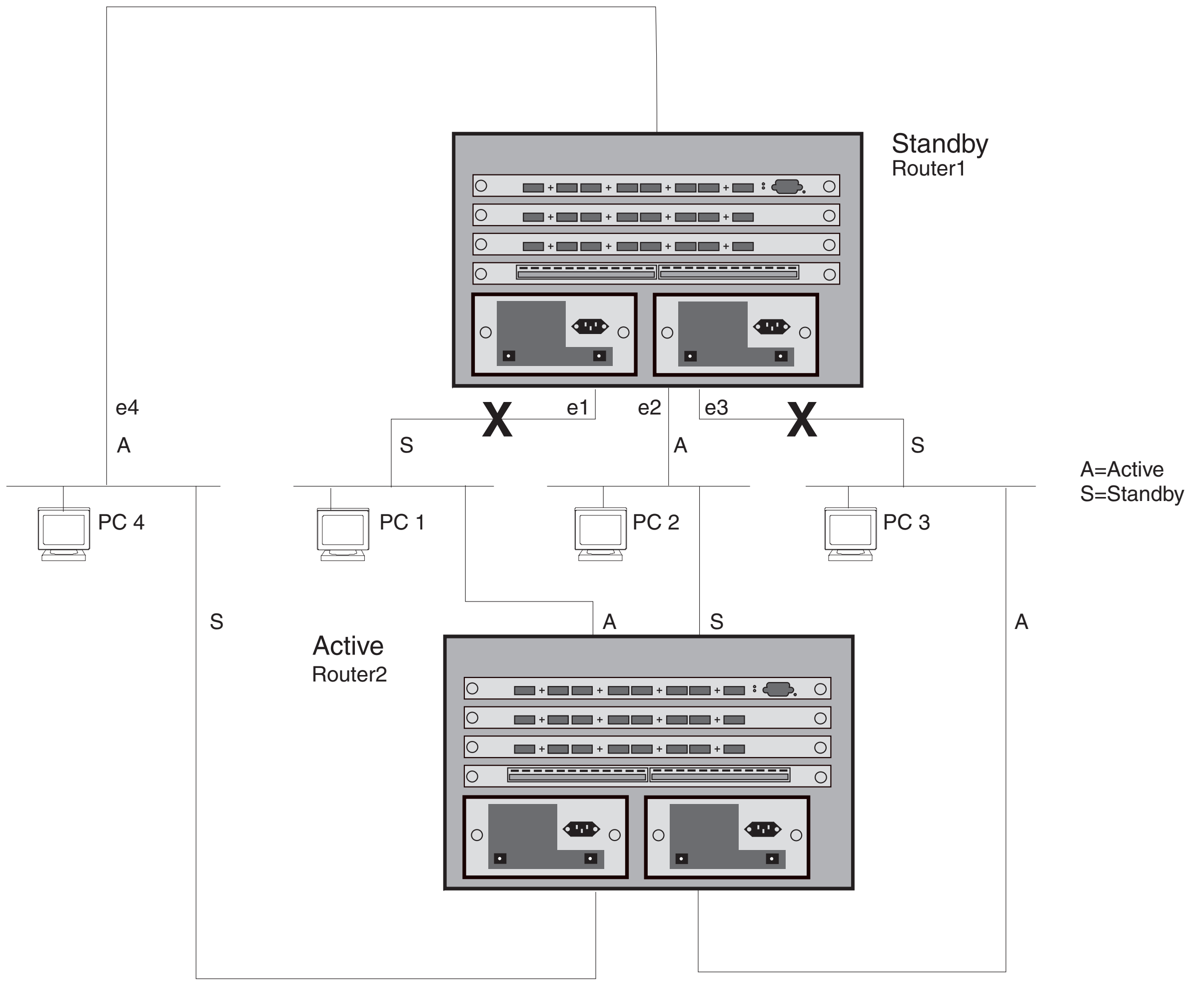


Figure 13.3 Failure of e1 and e3 links results in mixed active and standby links on router1 without the use of multiple track ports

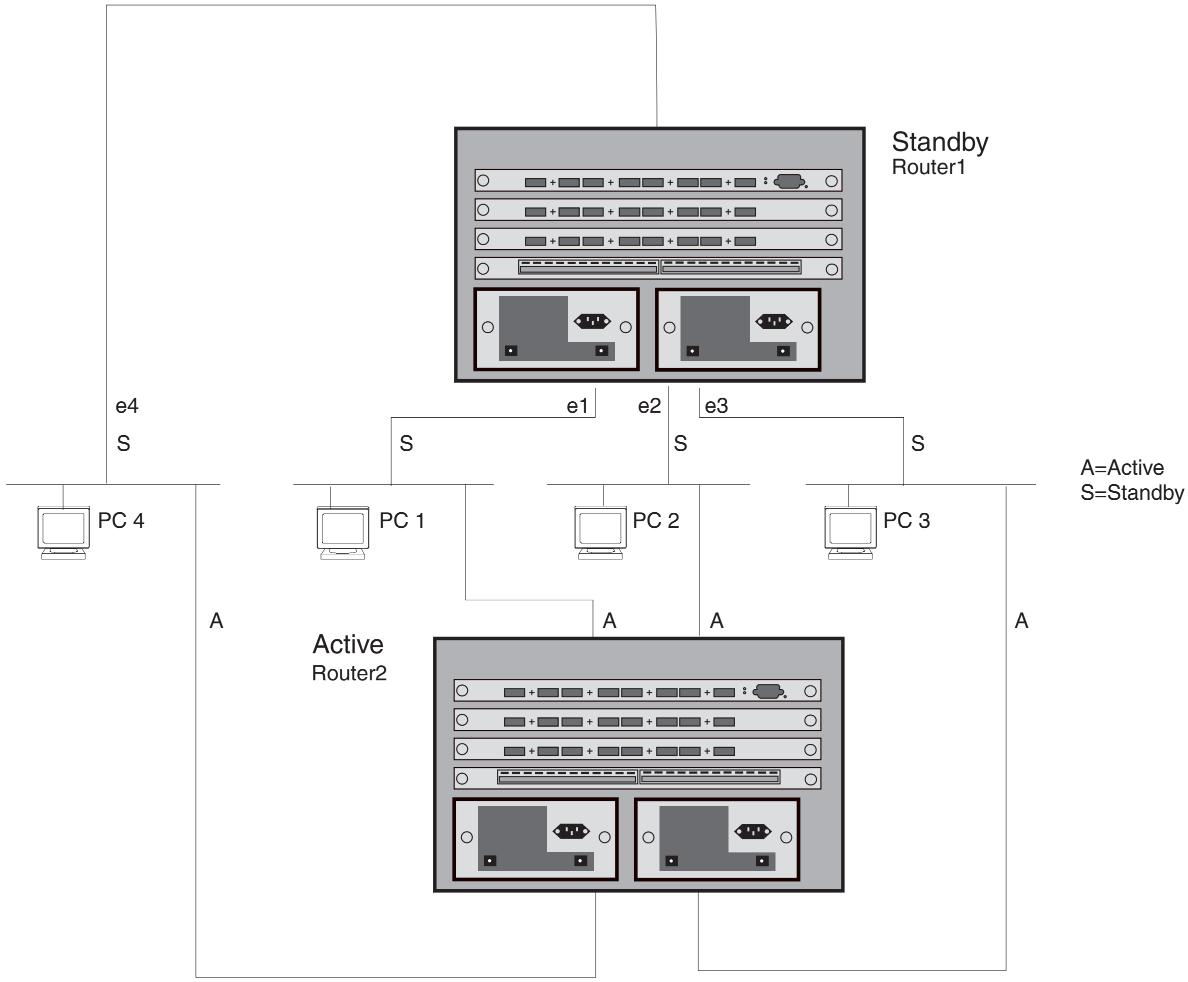


Figure 13.4 Router2 becomes active router after links e1 and e3 fail with multiple track ports defined

Independent Operation of RIP and OSPF

SRP operation is independent of the RIP and OSPF protocols. RIP and OSPF operation will be unaffected when SRP is enabled on its interfaces.

Dynamic SRP Configuration

All SRP global and interface parameters are dynamically activated. You do not need to reset the system to place SRP configuration parameters into effect.

Differences Between SRP and VRRP

The Virtual Router Redundancy Protocol (VRRP) is a standards-based protocol that provides redundancy to routers within a LAN. VRRP is described in RFC 2338. The implementation of VRRP on the HP 9304M, HP 9308M, and HP 6308M-SX routing switches provides many of the same features as SRP. In addition, VRRP enables you to configure third-party devices that adhere to RFC 2338 along with the HP 9304M, HP 9308M, and HP 6308M-SX routing switches as virtual routers. SRP requires that the other devices support SRP.

If you are configuring the HP 9304M, HP 9308M, and HP 6308M-SX routing switches for redundancy, you can use either protocol. The features provided by the two protocols are similar, yet the protocols do differ in the following ways:

- VRRP uses an IP multicast address for VRRP management traffic, while SRP uses pre-defined unicast addresses.
- VRRP uses real IP addresses assigned to an interface and does not use virtual IP addresses, whereas SRP must use one pre-defined virtual IP address for each virtual router. You can associate a VRRP virtual router with an IP address or with a virtual interface (a named set of physical interfaces).
- Each VRRP virtual router (denoted by a unique Virtual Router ID [VRID]) can have one Master router and one or more Backup routers. In contrast, each SRP router can have one Primary Router and only one Standby Router. Most VRRP and SRP configurations consist of two routers—one active router (Master or Primary) and one standby router (Backup or Standby).
- The implementation of VRRP on the HP 9304M, HP 9308M, and HP 6308M-SX routing switches supports authentication using simple clear text passwords. SRP does not support authentication.

NOTE: If your routing switches already are using SRP and you do not need redundancy with devices that cannot use SRP, you do not need to reconfigure your routing switches to use VRRP.

HP recommends that you do not use VRRP and SRP on the same device.

Configuring SRP

To begin using SRP on the routing switch:

1. Enable operation of SRP on the routing switch.
2. Configure SRP parameters on physical or virtual interfaces for those IP sub-nets for which a redundant path is desired. Configure the virtual router IP address and the other routing switch's IP address.
3. Assign track ports, if appropriate.
4. Assign one of the routing switches to serve as the active router using the preference parameter, as appropriate.
5. Modify interface parameters, keep-alive-time, and router-dead-interval on both routing switches as required.

NOTE: You initially enable SRP at the global CONFIG level of the CLI using the **router srp** command. All other parameters are assigned or modified at the interface level of the CLI using **ip srp address** <ip-addr> [<parameter>] commands.

NOTE: If you are using the Web Management interface, you enable SRP on the System configuration sheet. All other parameters (interface) are configured on the SRP configuration sheet.

Configuration Rules for SRP

- Virtual interfaces cannot be assigned as track ports.
- The keep-alive-time value must be set to the same value on both the active and standby router when both routers are connected to the same sub-net.
- The router-dead-time parameter must be set to the same value on both the active and standby routers when both routing switches are connected to the same sub-net.

Enable SRP on the Routing Switch

Before configuring SRP to provide redundancy for a routing switch, you must enable the feature on the routing switch.

USING THE CLI

To enable SRP on a routing switch, enter the following command:

```
HP9300(config)# router srp
```

USING THE WEB MANAGEMENT INTERFACE

To enable SRP on a routing switch:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Select the Enable radio button next to SRP.
3. Click the Apply button to apply the change to the device's running-config file.
4. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

NOTE: All SRP configurations are implemented using a single configuration panel of the Web management interface. Given this, all other configuration steps, other than enabling the feature, are shown in a separate section at the end of this chapter rather than interspersed with CLI examples.

Assign Virtual Router IP Addresses

In the examples in this section, SRP is used to provide a redundant path between Host 1 and Host 3 to ensure against failure of the primary path. See Figure 13.5.

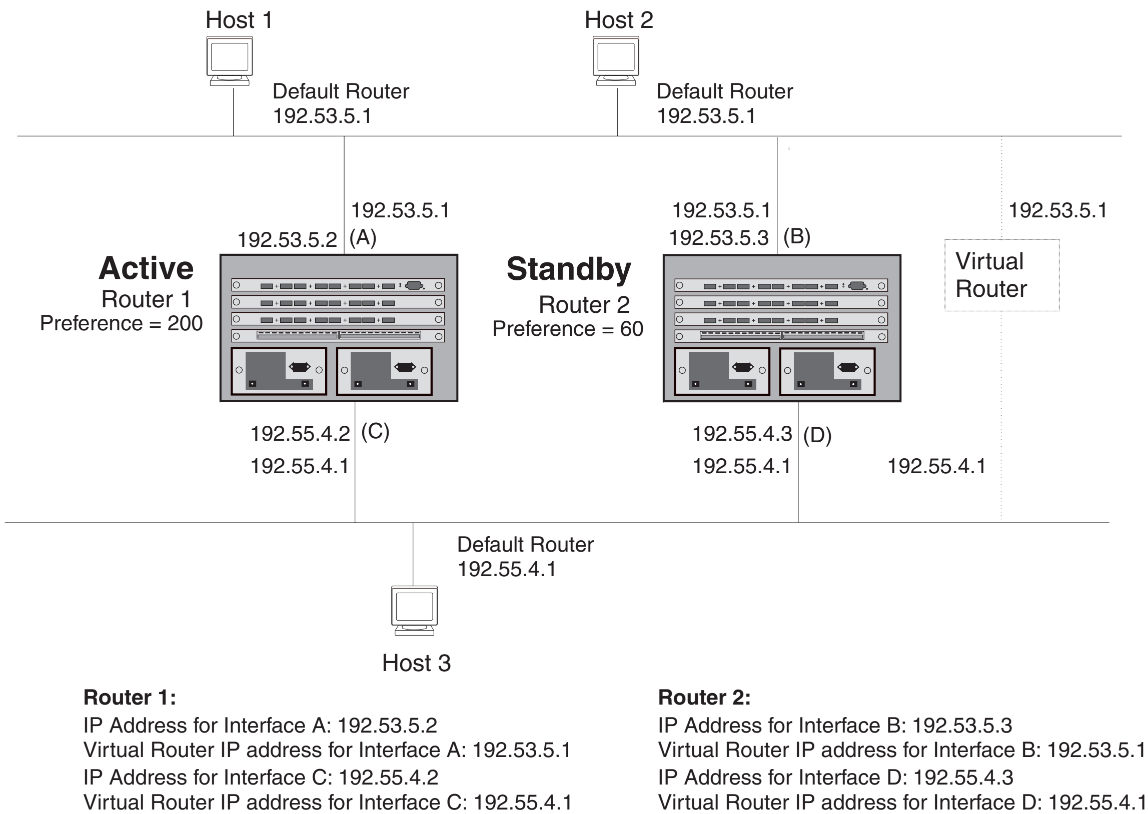


Figure 13.5 SRP operating in an HP 9304M network

USING THE CLI

EXAMPLE:

To define and assign the virtual router IP addresses for Router 1, shown in Figure 13.5, you would need to define two separate virtual IP addresses for interfaces A and C and link those addresses to the IP addresses of the physical interfaces for A and C.

This example assumes that interface A corresponds to physical interface 1/7, and interface C corresponds to physical interface 2/1.

Configuring Router 1

To establish the virtual IP address 192.53.5.1 for interface A defined by IP address 192.53.5.2 and Ethernet port 1/7, enter the following commands:

```
Router1(config)# inter e 1/7

Router1(config-if-1/7)# ip srp address 192.53.5.2 vir-rtr-ip 192.53.5.1
other-rtr-ip 192.53.5.3
```

Notice that the latter command also defines the other routing switch used in this configuration by entering the IP address for Interface B on Router 2 (**other-rtr-ip 192.53.5.3**).

To establish the virtual IP address 192.55.4.1 for interface C defined by IP address 192.55.4.2 and Ethernet port 2/1, enter the following commands:

```
Router1(config)# inter e 2/1
```

```
Router1(config-if-2/1)# ip srp address 192.55.4.2 vir-rtr-ip 192.55.4.1
other-rtr-ip 192.55.4.3
```

Notice that the latter command also defines the other routing switch used in this configuration by entering the IP address for Interface D on Router 2 (**other-rtr-ip 192.55.4.3**).

Configuring Router 2

To define and assign the virtual router IP address for Router 2, you would need to define two separate virtual IP addresses for interfaces B and D as well as linking those address to the IP addresses of the physical interfaces for A and C.

This example assumes that interface B corresponds to physical interface 1/7, and interface D corresponds to physical interface 2/2.

To establish the virtual IP address 192.53.5.1 for interface B defined by IP address 192.53.5.3 and Ethernet port 1/7, you would enter the following commands. Note that you also are defining the other routing switch used in this configuration by entering the IP address for interface A on Router 1 (**other-rtr-ip 192.53.5.2**).

```
Router2(config)# inter e 1/7
```

```
Router2(config-if-1/7)# ip srp address 192.53.5.3 vir-rtr-ip 192.53.5.1
other-rtr-ip 192.53.5.2
```

NOTE: The steps outlined in examples 1 and 2 also should be followed when creating and assigning the virtual router IP address 192.55.4.1 for interfaces C (192.55.4.2) and D (192.55.4.3).

Assign the Track Port(s)

Track ports monitor the relationship between the active and standby routers.

EXAMPLE:

To assign interface 1 to act as the track port for interface A (e1/7) on Router 1, enter the following commands:

```
Router1(config)# inter e 1/7
```

```
Router1(config-if-1/7)# ip srp address 192.53.5.2 track 1
```

NOTE: The IP address referenced in the track port assignment command is the IP address of the physical interface.

NOTE: The track port can also be assigned when assigning the virtual router IP address, as an extension to that command.

Assigning the Active Router

To establish one routing switch as active, assign it a higher ***preference level***. If the preference level for the two routing switches is equal, the interface with the higher IP address takes precedence as the active router.

EXAMPLE:

To make Router 1 the active router, assign a preference value to interfaces A and C that is higher than the preference value of interfaces B and D on Router 2.

To assign a preference value of 200 to interfaces A and C, you would enter the following commands:

```
Router1(config)# int e 1/7

Router1(config-if-1/7)# ip srp address 192.53.5.2 preference 200

Router1(config-if-1/7)# int e 2/1

Router1(config-if-2/1)# ip srp address 192.55.4.2 preference 200
```

Modify Port Parameters (optional)

The user can also modify two port parameters for SRP: the keep-alive-time and the router-dead-interval.

Keep Alive Time

The ***keep-alive-time*** parameter allows you to modify how often the SRP hello message is sent on the interface on which the keep-alive-time is configured.

EXAMPLE:

To modify the keep-alive-time parameter for interfaces A and C on Router 1 to 15 seconds from the default of 3 seconds, enter the following:

```
Router1(config)# int e 1/7

Router1(config-if-1/7)# ip srp 192.53.5.2 keep-alive-time 15

Router1(config-if-1/7)# int e 2/1

Router1(config-if-2/1)# ip srp 192.55.4.2 keep-alive-time 15
```

NOTE: The keep-alive-time value must be set to the same value on both the active and standby routers when both routers are connected to the same sub-net.

Router Dead Time

The ***router-dead-time*** parameter allows you to define the period of time (hold time) that the standby router waits before determining that the active router is unavailable (dead). If the configured period of time expires, the standby router becomes active.

NOTE: The router-dead-time parameter must be set to the same value on both the active and standby router when both routing switches are connected to the same sub-net.

EXAMPLE:

To modify the router-dead-time parameter for interfaces A and C on Router 1 to 30 seconds from the default of 9 seconds, you would enter the following:

```
Router1(config)# int e 1/7

Router1(config-if-1/7)# ip srp 192.53.5.2 router-dead-interval 30

Router1(config-if-1/7)# int e 2/1

Router1(config-if-2/1)# ip srp 192.55.4.2 router-dead-interval 30
```

USING THE WEB MANAGEMENT INTERFACE

EXAMPLE:

To define and assign the virtual router IP addresses for Router 1, shown in Figure 13.5, you would need to define two separate virtual IP addresses for interfaces A and C as well as linking those address to the IP addresses of the physical interfaces for A and C.

For purposes of this example we are assuming that interface A corresponds to physical interface 1/7 and interface C corresponds to physical interface 2/1.

To enable SRP on an interface:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the SRP link.
    - If the device does not have an SRP configuration, the SRP configuration panel is displayed.
    - If SRP is already configured but you are adding a new SRP configuration, click on the Add Interface link to display the SRP configuration panel.
    - If you are modifying an existing SRP configuration, click on the Modify button to the right of the row describing the configuration to display the SRP configuration panel.
4. Select the IP address to be configured from the IP Address field's pull down menu. For example, if you are initially assigning SRP to interface A (Router 1) as shown in Figure 13.5, select IP address 192.53.5.2.
5. Assign a virtual IP address for the virtual router. A virtual router IP address needs to be configured on at least one router in the SRP group. For interface A, you would assign 192.53.5.1, as shown in the network configuration of Figure 13.5.

NOTE: The default IP address for a virtual router is 0.0.0.0.

6. Enter the other router IP address. This is the physical IP address of the partner router's interface in the active-standby router relationship. Notice that in the case of the example (Figure 13.5), interface B on router 2 is designated as the standby router interface so IP address 192.53.5.3 is entered.
7. To establish a router as the active router in the redundancy configuration, a higher value should be entered for its preference level. In this case, because router 1 is the desired active router and the router currently being configured, a value of 200 is entered.
8. Modify the keep alive time parameter if a value other than the default value of 3 seconds is desired. For this configuration, modify the value to 15.

NOTE: The keep alive time parameter allows the user to modify how often the SRP hello message is sent on an interface. Possible values are 1 – 120 seconds. The default is 3 seconds.

NOTE: The keep alive time parameter must be set to the same value on both the active and standby routers when both routers are connected to the same sub-net.

9. Modify the dead time parameter if a value other than the default value of 9 seconds is desired. For this configuration you would modify the value to 30.

NOTE: The dead time parameter allows you to define the period of time (hold time) that the standby router will wait before determining that the active router is unavailable (dead). When the configured period of time expires, the standby router will become active. Possible values are 3 – 255. The default value is 9 seconds.

NOTE: The dead time parameter must be set to the same value on both the active and standby routers when both routers are connected to the same sub-net.

10. Select the track port by selecting a box next to the desired interface. For purposes of this example, you would select interface 1 as the track port for interface A on router 1.

NOTE: The track port is a physical port that is used to track the status of ports that provide redundant paths. If the software detects a change in state (up or down), the software increases or decreases the priority of the SRP Group Interface accordingly.

NOTE: If you are configuring a Chassis device, the track port options are listed in a slot/port combination (for example, 1/1, which indicates <slot>/<port>), indicating that the port is resident on a module in slot 1 of the HP 9304M or HP 9308M.

---

11. Repeat the steps above for each interface that is to be a redundant link. In this example, you would also need to configure interface B for router 1 and interfaces C and D for router 2.
12. Click the Add button to apply the changes to the device's running-config file.
13. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring SRP on Virtual Interfaces

A virtual interface will by default remain active until all underlying links go down. If you want the virtual link to go to SRP standby state when a subset of the ports goes down, you need to configure track ports.

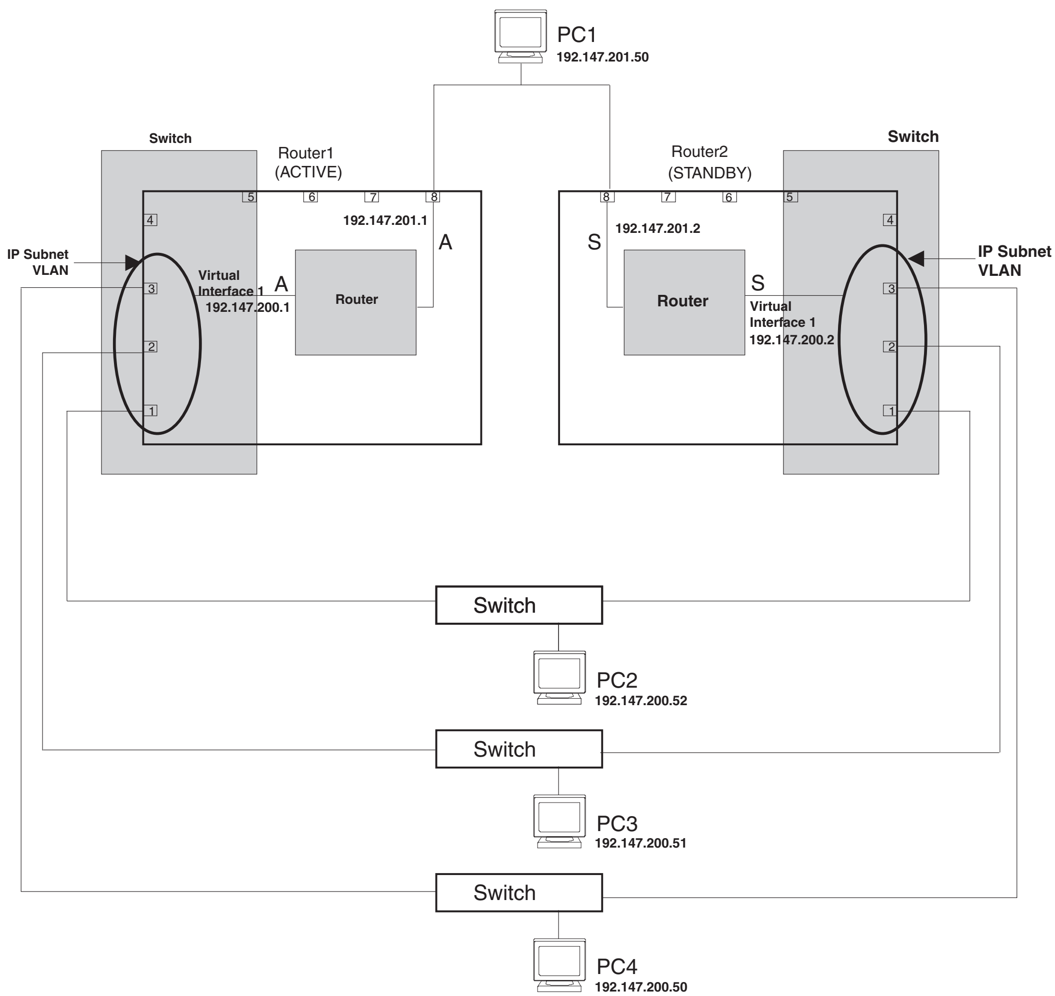


Figure 13.6 Configuring SRP on virtual interfaces

Configuring Multiple Track Ports for Virtual Interfaces

In Figure 13.6, Router 1 is the active router and Router 2 the standby router for all active SRP interfaces. Suppose you want Router 1 to go into the SRP standby state and establish Router 2 as the active router in case ports 1, 2, 3, or 8 on Router 1 go down. To do so, you would configure track ports for ports 1, 2, 3, and 8 on Router 1.

In preparation for track port configuration on Router 1, you would do the following:

1. Configure an IP sub-net VLAN with port membership of 1, 2, and 3 on Router 1.
2. Enable SRP on virtual interface 1.
3. Assign an IP address to virtual interface 1.
4. Assign ports 1, 2, 3, and 8 as track ports for virtual interface 1.
5. Assign an IP address to interface 8.
6. Assign ports 1, 2, and 3 as track ports for interface 8.

USING THE CLI

To configure the IP sub-net VLAN with port membership of 1, 2, and 3, you would enter the following commands:

```
HP9300(config)# vlan 1

HP9300(config-vlan-1)# ip-subnet 192.147.200.0 255.255.255.0

HP9300(config-vlan-ip-subnet)# static e1 to 3

HP9300(config-vlan-ip-subnet)# router-int ve1
```

To enable SRP on virtual interface 1 and to configure ports 1, 2, 3, and 8 as its track ports, you would enter the following commands:

```
HP9300(config)# int ve1

HP9300(config-vif-1)# ip address 192.147.200.1 255.255.255.0

HP9300(config-vif-1)# ip srp address 192.147.200.1 vir-rtr 192.147.200.100
other-rtr 192.147.200.2

HP9300(config-vif-1)# ip srp addr 192.147.200.1 track port 1 2 3 8
```

To enable SRP on physical interface 8 and to configure ports 1, 2, and 3 as its track ports, you would enter the following commands:

```
HP9300(config)# int e8

HP9300(config-if-8)# ip address 192.147.201.1 255.255.255.0

HP9300(config-if-8)# ip srp address 192.147.201.1 vir-rtr 192.147.201.100
other-rtr 192.147.200.2

HP9300(config-if-8)# ip srp addr 192.147.201.1 track port 1 2 3

HP9300(config-if-8)# end

HP9300# write memory
```

NOTE: After configuring track ports for Router 1, configure Router 2 similarly. This reciprocal configuration ensures that if Router 2 becomes the active router, it has track ports that support transfer to a SRP standby state.

NOTE: Virtual interfaces cannot be assigned as track ports.

USING THE WEB MANAGEMENT INTERFACE

You can select multiple track ports for SRP on the SRP configuration sheet.

Chapter 14
Configuring IPX

This chapter describes how to configure the Internet Packet Exchange (IPX) protocol on the HP 9304M, HP 9308M, and HP 6308M-SX routing switches using the CLI and Web management interface.

To display IPX configuration information and statistics, see “Displaying IPX Configuration Information and Statistics” on page 14-16.

For complete syntax information for the CLI commands shown in this chapter, see the *Command Line Interface Reference*.

Overview of IPX

The IPX protocol was created by Novell™. IPX is built upon a client-server networking architecture.

The Routing Information Protocol (RIP) and the Service Advertisement Protocol (SAP) are two key components of Novell NetWare and its IPX protocol suite. By default, Novell NetWare versions 3.x and 4.x broadcast RIP and SAP updates at 60 second intervals. NetWare uses these broadcasts to collect information for the routing and service tables that it uses for communicating.

NOTE: IPX/RIP is different from IP/RIP. IP/RIP configuration parameters do not apply to IPX/RIP and IPX/RIP parameters do not apply to IP/RIP.

Multiple IPX Frame Type Support per Interface

Up to four different IPX network numbers and frame encapsulation types can be defined for each IPX interface on a routing switch. The multiple encapsulation support allows you to define and receive traffic from four separate IPX networks on a single interface. Each network must have a distinct network number and encapsulation type (Ethernet SNAP, Ethernet 802.2, Ethernet 802.3, or Ethernet II).

Configuring IPX

To use IPX on the routing switch, perform the following tasks:

1. Enable IPX on the routing switch.
2. Enable NetBIOS on the system level.
3. Define the network number and frame type, and enable NetBIOS on IPX interfaces (optional).
4. Modify maximum number of RIP and SAP filters supported.
5. Define RIP, SAP, and forward filters (optional).

6. Assign RIP, SAP, and Forward filter groups (optional).
7. Modify the maximum number of SAP and RIP Route entries supported (optional).
8. Modify the hop count increment for RIP and SAP broadcast packets (optional).
9. Modify the maximum advertisement packet size for RIP and SAP packets (optional).
10. Modify the advertisement interval for RIP and SAP updates (optional).
11. Modify the age timer for learned RIP and SAP entries (optional).

Dynamic IPX Configuration

The IPX Protocol is by default disabled at system startup. When you first enable IPX, you must reset the system. However, after you reset the system all changes to the following parameters become effective immediately.

Global Parameters

- Enabling of NetBIOS Allow
- Defining IPX filters—Forward, RIP, and SAP

Interface Parameters

- Adding, deleting, or modifying IPX network numbers and frame types
- Adding, deleting, or modifying filter groups assigned to interfaces
- Modifying the RIP advertisement packet size
- Modifying the SAP advertisement packet size
- Modifying the RIP advertisement interval
- Modifying the SAP advertisement interval
- Modifying the age timer for learned IPX routes
- Modifying the age timer for learned SAP entries

Enable IPX

The IPX Protocol is by default disabled at system startup.

NOTE: Make sure you restart the system after enabling IPX. After you restart, additional IPX parameter settings take effect immediately.

USING THE CLI

To enable IPX, enter the following commands:

```
HP9300(config)# router ipx
HP9300(config)# exit
HP9300# write memory
HP9300# reload
```

Syntax: router ipx

USING THE WEB MANAGEMENT INTERFACE

To enable IPX:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Select the Enable radio button next to IPX.
3. Click the Apply button to apply the changes to the device’s running-config file.

4. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.
5. Click on the plus sign next to Command in the tree view to list the command options.
6. Select the Reload link and select Yes when prompted to reload the software. You must reload after enabling IPX to place the change into effect.

Enable NetBIOS

The routing switch can support routing of NetBIOS broadcasts (type 20) over IPX. IPX must be enabled on the routing switch and the interface level for it to be operational. By default, this feature is disabled.

USING THE CLI

To enable NetBIOS on the routing switch (system level), enter the following command:

```
HP9300(config)# ipx netbios-allow
```

Syntax: ipx netbios-allow | netbios-disallow

USING THE WEB MANAGEMENT INTERFACE

To enable NetBIOS (type 20) on the router and an interface:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IPX in the tree view to expand the list of IPX option links.
4. Click on the Allow NetBIOS (Type 20) link to display the NetBIOS panel.
5. Select Enable.
6. Click the Apply button to apply the changes to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

NOTE: After enabling NetBIOS at the global level, you need to enable NetBIOS at the interface level.

Assign IPX Network Number, Frame Type, Enable NetBios on an Interface

Once you enable IPX on the routing switch, you can assign IPX network numbers on an interface-by-interface basis. You also can enable NetBIOS broadcasts on an interface.

USING THE CLI

EXAMPLE:

To configure interfaces 1, 2, and 3 with the IPX network number and frame type shown in Figure 14.1, enter the following commands:

```
HP9300(config)# int e1/1
HP9300(config-if-1/1)# ipx network 100 ethernet_802.2
HP9300(config-if-1/1)# int e1/2
HP9300(config-if-1/2)# ipx network 200 ethernet_802.2
HP9300(config-if-1/2)# int e1/3
HP9300(config-if-1/3)# ipx network 300 ethernet_802.2
```

Syntax: ipx network <network-number> <frame-type> [netbios-allow | netbios-disallow]

NOTE: Once you configure an interface with a network number and frame type, you can define filters and assign them to the interface.

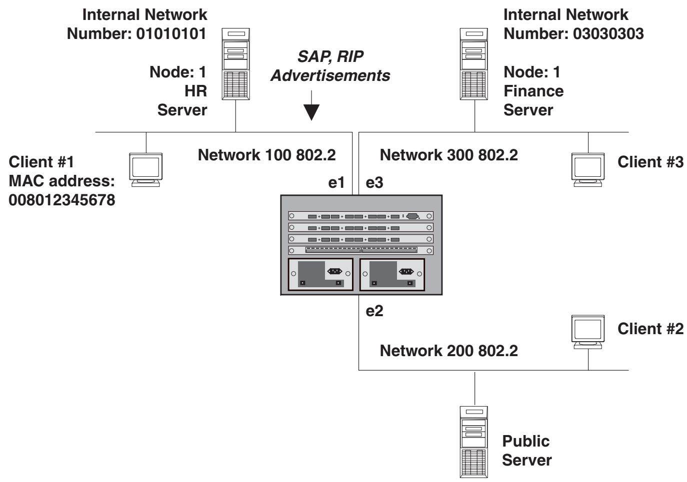
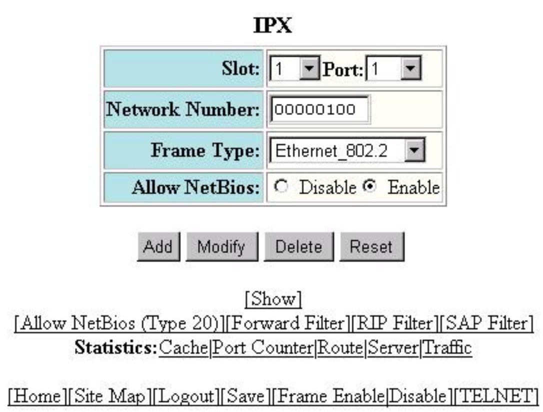


Figure 14.1 Defining and assigning IPX Forward, RIP and SAP filters

USING THE WEB MANAGEMENT INTERFACE

To assign IPX to interfaces 1, 2 and 3 as shown in Figure 14.1:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IPX in the tree view to expand the list of IPX option links.
4. Click on the Interface link.
    - If the device does not have an IPX interface configured, the IPX configuration panel is displayed, as shown in the following example.
    - If an IPX interface is already configured and you are adding a new one, click on the Configure IPX Interface link to display the IPX interface configuration panel, as shown in the following example.
    - If you are modifying an existing IPX interface, click on the Modify button to the right of the row describing the interface to display the IPX configuration panel, as shown in the following example.



5. Select the port or slot/port numbers to be configured as an IPX interface from the pull down menu.

6. Enter the network number.
7. Select the frame type from the pull down menu.
8. Enable NetBIOS if desired.
9. Click the Add button to apply the changes to the device's running-config file.
10. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Define and Assign a Forward Filter and Group

You can define a forward filter to allow a remote IPX client access to a restricted-access server. You can define up to 32 forward filters on a routing switch. Once you define the filter, you assign the filter to an interface by placing the filter in a forward filter group.

NOTE: A network number and frame type must be defined for the IPX interface before defining a forward filter.

EXAMPLE:

To allow IPX Client 1 on network 100 access to the finance server in Network 300 (Figure 14.1), define the following forward filter at the Global Level and then assign the filter to port 1/3 as a filter group.

NOTE: You can assign forward filters to either the input or output traffic on an interface.

USING THE CLI

```
HP9300(config)# ipx forward-filter 1 permit 100 008012345678 03030303 1 451

HP9300(config)# int e1/3

HP9300(config-if-1/3)# ipx forward-filter-group in 1
```

Syntax: ipx forward-filter <filter-id> permit | deny <source-network-number> | any <source-node-number> | any <destination-network-number> | any <destination-node-number> | any <destination-socket-number> | any

Syntax: ipx forward-filter-group in | out <filter-id>

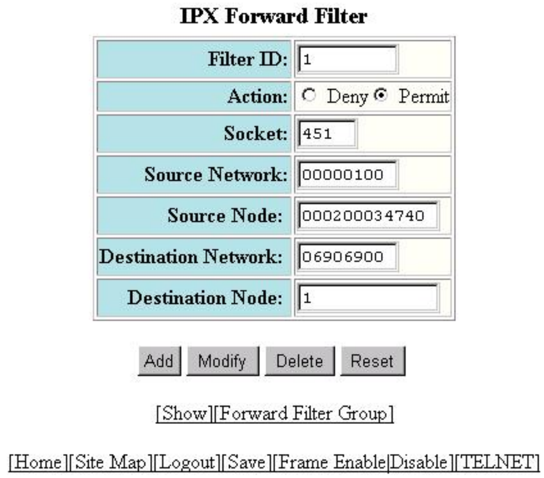
NOTE: When you define filters, the network number for a server is its internal network number. The node number for a client is the client's MAC address. The value 1 represents a server.

USING THE WEB MANAGEMENT INTERFACE

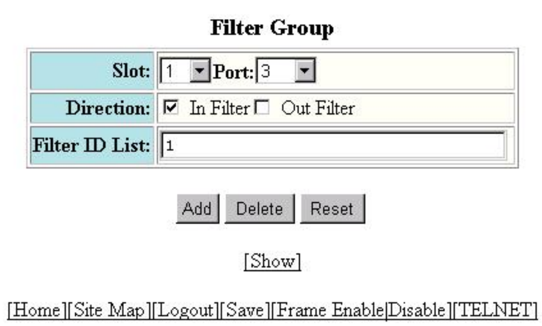
EXAMPLE:

To allow IPX Client 1 on network 100 access to the finance server in Network 300 (Figure 14.1), define the following forward filter at the Global Level and then assign it to port 1/3 as a filter group.

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IPX in the tree view to expand the list of IPX option links.
4. Click on the Forward Filter link.
   - If the device does not have an IPX forward filter configured, the IPX Forward Filter configuration panel is displayed, as shown in the following example.
   - If an IPX forward filter is already configured and you are adding a new one, click on the Add Forward Filter link to display the IPX Forward Filter configuration panel, as shown in the following example.
   - If you are modifying an existing IPX forward filter, click on the Modify button to the right of the row describing the filter to display the IPX Forward Filter configuration panel, as shown in the following example.



5. Enter a filter ID value from 1 – 32.
6. Select either Permit or Deny.
7. Enter the appropriate number for the destination socket of the application running in the Socket field. If you enter all zeros in this field, the filter will accept any socket.
8. Enter the Source Network Address on which you want to filter traffic. If you enter all zeros in this field, the filter will accept any source network.
9. Enter the address of the Source Node within the source network on which you want to filter traffic.
10. Enter the Destination network number. If you enter all zeros in this field, the filter will accept any destination network number.
11. Enter the Destination Node network number. If you enter all zeros in this field, the filter will accept any destination node network number.
12. Click the Add button to apply the changes to the device's running-config file.
13. Select the Forward Filter Group link.
    - If the device does not have an IPX forward filter group configured, the Filter Group configuration panel is displayed, as shown in the following example.
    - If an IPX forward filter group is already configured and you are adding a new one, click on the Add Forward Filter Group link to display the IPX Filter Group configuration panel, as shown in the following example.
    - If you are modifying an existing IPX forward filter group, click on the Modify button to the right of the row describing the group to display the IPX Filter Group configuration panel, as shown in the following example.



14. Select the port or slot/port combination to which you are assigning the filter(s).
15. Check either or both of the In Filter and Out Filter boxes. If you check the In Filter box, all incoming traffic is filtered as defined. If you check the Out Filter box, all outgoing traffic is filtered. By selecting both the In Filter and Out Filter boxes, you can assign the filters to both incoming and outgoing traffic.
16. Enter the filter ID(s) that you want to assign to the port. You can enter multiple filters entries separated by commas or blanks.
17. Click the Add button to apply the changes to the device's running-config file.
18. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Define and Assign an IPX/RIP Filter and Group

You can define a filter for a routing switch to block RIP routes being advertised to other parts of the network. You define RIP filters at the global level and assign them on either a global or interface basis. You can apply filters to either incoming or outgoing traffic. You can define up to 128 IPX/RIP filters on a routing switch.

NOTE: An IPX interface must be defined on the routing switch before you can assign a filter to that interface.

EXAMPLE:

To block RIP routes from being advertised outside of Network 100, shown in Figure 14.1, define and assign the following RIP filter on interface 1.

USING THE CLI

```
HP9300(config)# ipx rip-filter 1 deny 100 01010101 any
HP9300(config)# int e1/1
HP9300(config-if-1/1)# ipx rip-filter-group in 1
```

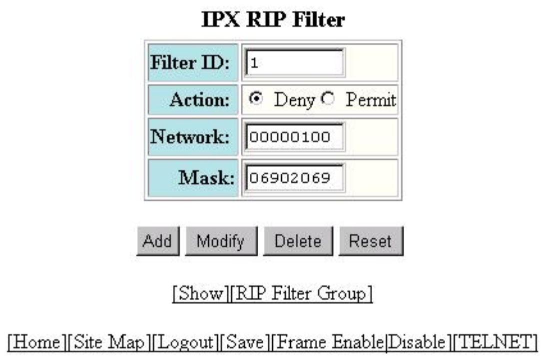
Syntax: ipx rip-filter <filter-id> permit | deny <network-number> | any <network-mask> | any

Syntax: ipx rip-filter-group in | out <filter-id>

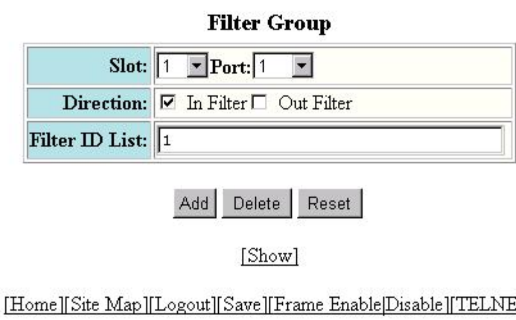
USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to IPX in the tree view to expand the list of IPX option links.
4. Click on the RIP Filter link.
   - If the device does not have an IPX RIP filter configured, the IPX RIP Filter configuration panel is displayed, as shown in the following example.
   - If an IPX RIP filter is already configured and you are adding a new one, click on the Add RIP Filter link to display the IPX RIP Filter configuration panel, as shown in the following example.

- If you are modifying an existing IPX RIP filter, click on the Modify button to the right of the row describing the filter to display the IPX RIP Filter configuration panel, as shown in the following example.



5. Enter a Filter ID value in the Filter ID field.
6. Select either Permit or Deny.
7. Enter the source network address on which you want to filter traffic in the Network field. You also can assign a wildcard value of all zeros (00000000) to allow all entries. The zeroes appear as 'any' in the display.
8. Enter the source network address mask for the network address in the Mask field. You can assign a wildcard value of all zeros (00000000) to allow all entries. The zeroes appear as 'any' in the display.
9. Click the Add button to apply the changes to the device's running-config file.
10. Select the RIP Filter Group link.
    - If the device does not have an IPX RIP filter group configured, the Filter Group configuration panel is displayed, as shown in the following example.
    - If an IPX RIP filter group is already configured and you are adding a new one, click on the Add RIP Filter Group link to display the Filter Group configuration panel, as shown in the following example.
    - If you are modifying an existing IPX RIP filter group, click on the Modify button to the right of the row describing the group to display the Filter Group configuration panel, as shown in the following example.



11. Select the port to which you want to assign the filter(s).
12. Check either or both of the In Filter and Out Filter boxes. If you check the In Filter box, all incoming traffic is filtered. If you check the Out Filter box, all outgoing traffic is filtered. If you check both In Filter and Out Filter, the assigned filters apply to both incoming and outgoing traffic.
13. Enter the filter ID(s) you want to assign to the port. You can enter multiple filter entries separated by commas or blanks.
14. Click the Add button to apply the changes to the device's running-config file.
15. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring IPX SAP Access Control Lists (ACLs)

You can configure Access Control Lists (ACLs) for filtering Service Advertisement Protocol (SAP) replies sent on a routing switch's IPX interfaces. You configure IPX SAP access lists on a global basis, then apply them to the IPX inbound or outbound filter group on specific interfaces. You can configure up to 32 access lists. The same access list can be applied to multiple interfaces.

When you configure more than one access list on an IPX interface, the software applies the access lists in numerical order. For example, if you configure access lists 1, 10, and 32 and apply them to an interface, the software applies access list 1 first, then access list 10, then access list 32. This is true regardless of the order in which you configure the access lists. At the first match, the software takes the action specified by the access list (deny or permit) and stops comparing the update against the access lists.

IPX SAP access lists apply to SAP updates sent or received by the routing switch. You can apply them to a port's inbound or outbound IPX traffic.

NOTE: IPX access lists replace the IPX filter mechanism in software releases earlier than 06.x. The older commands are supported for backward compatibility but are not listed in the on-line help. If the devices' startup-config file contains IPX filter commands of the older format, they are replaced by equivalent IPX ACL commands when you save the device's configuration while running 06.x or later.

Before you configure an access list on an IPX interface, all SAP updates are sent and received by default. However, once you configure an access filter, the default action changes from permit to deny. Thus, SAP updates that are not explicitly permitted are denied. To change the default action to permit, configure SAP access list 32 to permit all updates on all networks.

NOTE: Each IPX SAP access list is a single filter. This is different from the system-wide ACLs, which each can contain multiple individual filters. See "Using Access Control Lists (ACLs)" on page 3-1.

To configure IPX access lists, use the following CLI method.

USING THE CLI

To configure three IPX access lists and apply them to IPX interfaces on port 1/1, enter the following commands:

```
HP9300(config)# router ipx
HP9300(config)# ipx sap-access-list 1 deny abcd
HP9300(config)# ipx sap-access-list 10 deny efef.1234.1234.1234
HP9300(config)# ipx sap-access-list 32 permit -1 0
HP9300(config)# exit
HP9300(config)# int e 1/1
HP9300(config-if-1/1)# ipx sap-filter-group out 1 10 32
HP9300(config-if-1/1)# write memory
```

In this example, access list 1 denies all SAP updates containing IPX network abcd. Access list 10 denies SAP updates for print server "Prt1" from network efef, node 1234.1234.1234. Access list 32 ensures that all updates that are not denied by the preceding access lists are permitted.

Syntax: [no] ipx sap-access-list <num> deny | permit <network>[.<node>] [<network-mask>.<node-mask>] [<service-type> [<server-name>]]

Syntax: [no] ipx sap-filter-group in | out <num> [<num>…]

The <num> parameter specifies the access list number and can be from 1 – 32.

The **deny | permit** parameter specifies whether the routing switch allows the SAP update or denies it.

The <network>[.<node>] parameter specifies the IPX network. Optionally, you also can specify a specific node (host) on the network. The <network> parameter can be an eight-digit hexadecimal number from 1 – FFFFFFFE. To specify all networks ("any"), enter –1 as the network number. If the network number has leading zeros, you do not need to specify them. For example, you can specify network 0000abab as "abab".

The node is a 48-bit value represented by three four-digit numbers joined by periods; for example, 1234.1234.1234.

The [<network-mask>.<node-mask>] parameter lets you specify a comparison mask for the network and node. The mask consists of zeros (0) and ones (f). Ones indicate significant bits. For example, to configure a mask that matches on network abcdef*xx*, where *xx* can be any value and the node address can be any value, specify the following mask: ffffff00.0000.0000.0000

NOTE: To apply an ACL for filtering GNS replies to an interface, you must use the **ipx output-gns-filter** command instead of the **ipx sap-filter-group** command. See “Filter GNS Replies” on page 14-10.

The **in | out** parameter of the **ipx sap-filter-group** command specifies whether the ACLs apply to incoming traffic or outgoing traffic.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure a SAP access list using the Web management interface.

Enable Round-Robin GNS Replies

By default, the routing switch replies to a GNS request with the most recently learned server supporting the requested service. You configure the routing switch to instead use round-robin to rotate among servers of a given service type when responding to GNS requests. To do so, use one of the following methods.

USING THE CLI

To enable the routing switch to use round-robin to select servers for replies to GSN requests, enter the following commands:

```
HP9300(config)# ipx gns-round-robin
HP9300(config)# write memory
```

Syntax: [no] ipx gns-round-robin

USING THE WEB MANAGEMENT INTERFACE

You cannot enable round-robin for GNS replies using the Web management interface.

Filter GNS Replies

You can use IPX access lists to permit or deny specific services and servers in GNS replies to specific IPX nodes (hosts). To do so, use either of the following methods to configure IPX access lists that include service and server information, then apply them to specific ports.

USING THE CLI

To configure IPX ACLs and apply them to a port to control responses to GNS requests on that port, enter commands such as the following:

```
HP9300(config)# router ipx
HP9300(config-ipx-router)# ipx sap-access-list 2 deny efff 47 Prt0
HP9300(config-ipx-router)# ipx sap-access-list 20 deny aaaa.bbbb.cccc.dddd 47 Prt1
HP9300(config-ipx-router)# ipx sap-access-list 32 permit -1 0
HP9300(config-ipx-router)# exit
HP9300(config)# int e 1/1
HP9300(config-if-1/1)# ipx output-gns-filter 10 20 32
HP9300(config-if-1/1)# write memory
```

The commands in this example configure three ACLs. Two of the ACLs contain server network, service type, and server information and deny reporting these servers to the clients. For example, ACL 2 does not permit the routing switch from sending server “Prt0” with network efff in GNS replies to the client.

ACL 32 changes the default action from deny to permit. All GNS replies that are not explicitly denied by other ACLs are permitted by this one.

Syntax: [no] ipx sap-access-list <num> deny | permit <network>[.<node>] [<network-mask>.<node-mask>] [<service-type> [<server-name>]]

The <service-type> [<server-name>] parameter lets you specify a service type and, optionally, a specific server. Use these parameters when you are configuring an ACL for filtering Get Nearest Server (GNS) replies. The service type is a hexadecimal number. To specify all service types ("any"), enter 0. For a list of service types, see the software documentation for your IPX servers. If you also enter the sever name, the access list applies only to updates for that server, not to other serves of the same type.

For information about the other parameters, see "Configuring IPX SAP Access Control Lists (ACLs)" on page 14-9.

Syntax: [no] ipx output-gns-filter <num> [<num>…]

USING THE WEB MANAGEMENT INTERFACE

You cannot configure GNS reply filters using the Web management interface.

Disable GNS Replies

When IPX is enabled in the routing switch, the device responds to all GNS requests by default. You can disable GNS replies on individual routing switch ports. Use one of the following methods to do so.

USING THE CLI

To disable IPX GNS replies on port 1/1, enter the following commands. GNS replies are disabled for all IPX interfaces on the port.

```
HP9300(config)# int eth 1/1
HP9300(config-if-1/1)# ipx gns-reply-disable
HP9300(config-if-1/1)# write memory
```

Syntax: [no] ipx gns-reply-disable

USING THE WEB MANAGEMENT INTERFACE

You cannot disable IPX GNS replies using the Web management interface.

Modify Maximum SAP and RIP Route Entries

You can define the maximum number of IPX/RIP and IPX/SAP routes that the router can store and forward.

- From 64 – 8192 RIP entries can be defined. The default number of RIP entries supported is 2048.
- From 64 – 8192 SAP entries can be defined. The default number of SAP entries supported is 4096.

NOTE: IPX must be enabled on the router for these items to be configurable.

USING THE CLI

To limit the number of RIP entries stored to 3000 from a default of 2048, enter the following command:

```
HP9300(config)# system-max ipx-rip-entry 3500
```

Syntax: system-max ipx-rip-entry <value>

To limit the number of SAP entries stored to 6000 from a default of 4096, enter the following command:

```
HP9300(config)# system-max ipx-sap-entry 6000
```

Syntax: system-max ipx-sap-entry <value>

USING THE WEB MANAGEMENT INTERFACE

To modify the maximum number of RIP or SAP route entries supported on a router:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Select the Max-Parameter link to display the Configure System Parameter Maximum Value table. This table lists the settings and valid ranges for all the configurable table sizes on the device.
3. Click the Modify button next to ipx-rip-entry or ipx-sap-entry.

4. Enter the new value for the table size. The value you enter specifies the maximum number of entries the table can hold.
5. Click Apply to save the changes to the device's running-config file.
6. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.
7. Click on the plus sign next to Command in the tree view to list the command options.
8. Select the Reload link and select Yes when the Web management interface asks you whether you really want to reload the software. Changes to table sizes do not take effect until you reload the software.

Modify RIP and SAP Hop Count Increment

You can modify the incremental value (hop) that the routing switch adds to a RIP or SAP record before propagating the record to the next interface. By default, a value of one is added to a record before it is broadcast to the next interface.

In a network of parallel routers, the router that receives a RIP or SAP record with the lowest hop count is seen as the router with the most optimal information and is seen as the primary router. As primary router, it is elected to forward the packet to the next interface.

You can manage which router is selected as the primary router by a host by modifying the hop count assigned to an IPX interface. For example, in Figure 14.2, an administrator wants to ensure that all traffic between server1 and server2 is routed through router 1 and that router 1 is seen as the primary router. To ensure that this occurs, the administrator can assign higher hop counts (for example, 10) to the router interfaces on router 2.

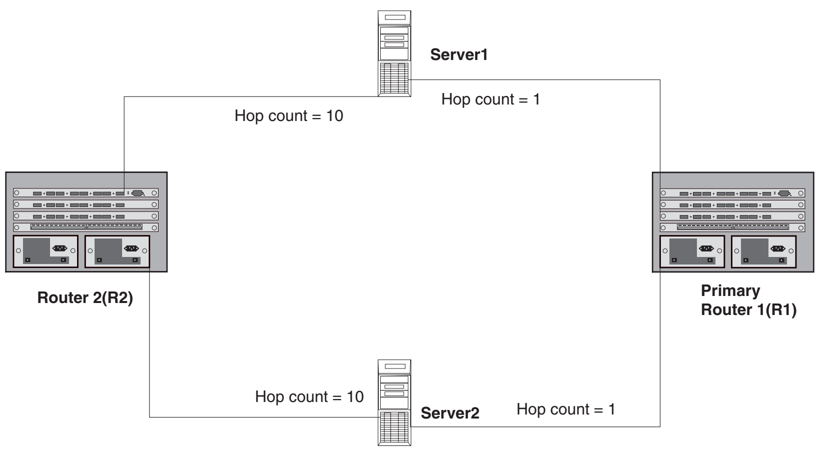


Figure 14.2 Using higher hop count assignments to bias traffic away from the router

USING THE CLI

To increase the hop count increment assessed to interface 1/5, enter the following commands:

```
HP9300(config)# int e 1/5
HP9300(config-if-1/5)# ipx-rip-update-hop-count-increment 10
HP9300(config-if-1/5)# ipx-sap-update-hop-count-increment 10
```

Syntax: ipx-rip-update-hop-count-increment <2-15>, ipx-sap-update-hop-count-increment <2-15>

USING THE WEB MANAGEMENT INTERFACE

You cannot modify hop count increments using the Web management interface.

Modify the RIP Advertisement Packet Size

The default IPX RIP packet size is 432 bytes, which allows 50 routes plus 32 bytes of header in an IPX RIP update packet. Each route requires eight bytes. You can configure the packet size to be from 40 bytes (enough for one route) – 1488 bytes (enough for 182 routes).

NOTE: You can specify packet length that does not fall evenly on a route or server boundary. The device will use the packet size but will include only the number of routes or servers that fit entirely within the packet.

To change the RIP advertisement packet size, use the following CLI method.

USING THE CLI

EXAMPLE:

To change the maximum packet size of IPX RIP advertisements sent on interface 1/1 from the default 432 bytes to 832 bytes, enter the following command. This command increases the number of IPX RIP routes an advertisement packet holds from 50 to 100.

```
HP9300(config) int e 1/1
HP9300(config-if-1/1) ipx rip-max-packetsize 832
HP9300(config-if-1/1) write memory
```

Syntax: ipx rip-max-packetsize <bytes>

The number of bytes can be from 40 bytes (enough for one route) – 1488 bytes (enough for 182 routes). The default is 432 bytes.

USING THE WEB MANAGEMENT INTERFACE

You cannot modify the RIP advertisement packet size using the Web management interface.

Modify the SAP Advertisement Packet Size

The default IPX SAP packet size is 480 bytes, which allows seven servers plus 32 bytes of header in an IPX SAP update packet. Each server requires 64 bytes. You can configure the packet size to be from 96 bytes (enough for one server) – 1440 bytes (enough for 22 servers).

NOTE: You can specify packet length that does not fall evenly on a route or server boundary. The device will use the packet size but will include only the number of routes or servers that fit entirely within the packet.

To change the SAP advertisement packet size, use the following CLI method.

USING THE CLI

EXAMPLE:

To change the maximum number of bytes in IPX SAP advertisements sent on interface 5/1 from 480 to 672 (enough for 10 servers plus the 32 bytes of packet header), enter the following commands:

```
HP9300(config) int e 5/1
HP9300(config-if-5/1) ipx sap-max-packetsize 672
HP9300(config-if-5/1) write memory
```

Syntax: ipx sap-max-packetsize <bytes>

The number of bytes can be from 96 bytes (enough for one server) – 1440 bytes (enough for 22 servers). The default is 480 bytes.

USING THE WEB MANAGEMENT INTERFACE

You cannot modify the SAP advertisement packet size using the Web management interface.

Modify the RIP Advertisement Interval

The IPX RIP advertisement interval specifies how often the routing switch sends IPX RIP updates to neighboring IPX routers. The update intervals are separate for RIP and SAP and are configurable on an individual interface basis.

By default, the routing switch sends an IPX RIP update every 60 seconds. You can change the interval to be from 10 – 65535 seconds. You cannot disable the advertisements.

NOTE: If you change an advertisement interval, you do not need to change the age time. The software automatically calculates the age time by multiplying the advertisement interval times the age timer, which is 3 by default.

To change the RIP advertisement interval, use the following CLI method.

USING THE CLI

EXAMPLE:

To change the advertisement interval for IPX RIP advertisements sent on interface 1/1 from 60 seconds to 30 seconds, enter the following commands:

```
HP9300(config) int e 1/1
HP9300(config-if-1/1) ipx update-time 30
HP9300(config-if-1/1) write memory
```

Syntax: ipx update-time <interval>

The <interval> can be from 10 – 65535 seconds. The default is 60.

USING THE WEB MANAGEMENT INTERFACE

You cannot modify the RIP advertisement interval using the Web management interface.

Modify the SAP Advertisement Interval

The IPX SAP advertisement interval specifies how often the routing switch sends IPX SAP updates to neighboring IPX routers. The update intervals are separate for RIP and SAP and are configurable on an individual interface basis.

By default, the routing switch sends an IPX SAP update every 60 seconds. You can change the interval to be from 10 – 65535 seconds. You cannot disable the advertisements.

NOTE: If you change an advertisement interval, you do not need to change the age time. The software automatically calculates the age time by multiplying the advertisement interval times the age timer, which is 3 by default.

To change the SAP advertisement packet size, use the following CLI method.

USING THE CLI

EXAMPLE:

To change the advertisement interval for IPX SAP advertisements sent on interface 1/1 from 60 seconds to 120 seconds, enter the following commands:

```
HP9300(config) int e 1/1
HP9300(config-if-1/1) ipx sap-interval 120
HP9300(config-if-1/1) write memory
```

Syntax: ipx sap-interval <interval>

The <interval> can be from 10 – 65535 seconds. The default is 60.

USING THE WEB MANAGEMENT INTERFACE

You cannot modify the SAP advertisement interval using the Web management interface.

Modify the Age Timer for Learned IPX Routes

The age timer specifies how many seconds a learned IPX route can remain in the routing switch's IPX route table before aging out.

The software calculates the age time by multiplying the advertisement interval times the age timer. For example, the default age time for IPX routes is 180 seconds, which is 60 (the default advertisement interval) multiplied by 3 (the default age timer).

You can configure the age timer for RIP to a value from 1 – 65535. The default is 3. You cannot disable the age timer.

To change the age timer for learned IPX routes, use the following CLI method.

USING THE CLI

To change the age timer for IPX routes from 3 to 4 on interface 1/1, enter the following commands.

```
HP9300(config) int e 1/1
HP9300(config-if-1/1) ipx rip-multiplier 4
HP9300(config-if-1/1) write memory
```

Syntax: ipx rip-multiplier <num>

The <num> parameter specifies the age time and can be from 1 – 65535. The default is 3.

USING THE WEB MANAGEMENT INTERFACE

You cannot modify the route age timer using the Web management interface.

Modify the Age Timer for Learned SAP Entries

The age timer specifies how many seconds a learned IPX server can remain in the routing switch's IPX service table before aging out.

The software calculates the age time by multiplying the advertisement interval times the age timer. For example, the default age time for IPX service entries is 180 seconds, which is 60 (the default advertisement interval) multiplied by 3 (the default age timer).

You can configure the age timer for SAP to a value from 1 – 65535. The default is 3. You cannot disable the age timer.

To change the age timer for learned SAP entries, use the following CLI method.

USING THE CLI

To change the age timer for IPX servers from 3 to 2 on interface 5/1, enter the following commands.

```
HP9300(config) int e 5/1
HP9300(config-if-5/1) ipx sap-multiplier 2
HP9300(config-if-5/1) write memory
```

Syntax: ipx sap-multiplier <num>

The <num> parameter specifies the age time and can be from 1 – 65535. The default is 3.

USING THE WEB MANAGEMENT INTERFACE

You cannot modify the SAP age timer using the Web management interface.

Displaying IPX Configuration Information and Statistics

You can use CLI commands and Web management options to display the following IPX information:

- Global IPX parameter settings – see “Displaying Global IPX Configuration Information” on page 14-16.
- IPX interfaces – see “Displaying IPX Interface Information” on page 14-17.
- IPX forwarding cache – see “Displaying the IPX Forwarding Cache” on page 14-19.
- IPX route table – see “Displaying the IPX Route Table” on page 14-20.
- IPX server table – see “Displaying the IPX Server Table” on page 14-21.
- IPX traffic statistics – see “Displaying IPX Traffic Statistics” on page 14-22.

Displaying Global IPX Configuration Information

To display global IPX configuration information for the routing switch, use one of the following methods.

USING THE CLI

To display IPX configuration information, enter the following command at any CLI level:

```
HP9300> show ipx

IPX Enabled
NetBIOS (type 20): Disallowed

Maximum RIP entries: 2048
Maximum SAP entries: 4096

Maximum IPX RIP filters: 32
Maximum IPX SAP filters: 32
Maximum IPX forward filters: 32
```

Syntax: show ipx

This display shows the following information.

Table 14.1: CLI Display of Global IPX Configuration Information

This Field...	Displays...
IPX Enabled	Verifies that IPX is enabled. **Note**: If IPX is disabled, the following message is displayed in stead: “ipx not running”
IPX NetBIOS (type 20)	Indicates whether IPX is configured to allow NetBIOS type 20 packets. This field can have one of the following values: • Allowed • Disallowed To change this parameter, see “Enable NetBIOS” on page 14-3.
Maximum IPX RIP filters	How many IPX route filters you can configure in the routing switch. On some devices, you can change this value by changing the amount of memory allocated for the filters. See “Displaying and Modifying System Parameter Default Settings” in the “Configuring Basic Features” chapter of *Installation and Getting Started Guide*.

Table 14.1: CLI Display of Global IPX Configuration Information (Continued)

This Field...	Displays...
Maximum IPX SAP filters	How many IPX service filters you can configure in the routing switch. On some devices, you can change this value by changing the amount of memory allocated for the filters. See “Displaying and Modifying System Parameter Default Settings” in the “Configuring Basic Features” chapter of *Installation and Getting Started Guide*.
Maximum IPX forward filters	How many IPX forward filters you can configure in the routing switch. On some devices, you can change this value by changing the amount of memory allocated for the filters. See “Displaying and Modifying System Parameter Default Settings” in the “Configuring Basic Features” chapter of *Installation and Getting Started Guide*.

USING THE WEB MANAGEMENT INTERFACE

To determine whether IPX is enabled:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Verify that the Enable option is selected next to IPX. If the option is not selected and you want to enable IPX, see “Enable IPX” on page 14-2.

To determine whether NetBIOS is enabled or disabled:

1. Click on the plus sign next to Configure.
2. Click on the plus sign next to IPX in the tree view to expand the list of IPX option links.
3. Click on the Allow NetBIOS (Type 20) link. Verify that Enable is selected.

To view the maximum number of IPX filters you can configure:

1. Click the Home link from any panel to display the System configuration panel.
2. Select the Max-Parameter link to display the Configure System Parameter Maximum Value table. This table lists the settings and valid ranges for all the configurable table sizes on the device.
3. Scroll down to display the values in the Max Current Value field for the following parameters:
   - ipx-forward-filter – IPX forward filters
   - ipx-rip-filter – IPX RIP filters
   - ipx-sap-filter – IPX SAP filters

Displaying IPX Interface Information

To display IPX interface information for the routing switch, use one of the following methods.

USING THE CLI

To display IPX interface information, enter the following command at any CLI level:

```
HP9300# show ipx interface ethernet 3/5

Interface Ethernet 3/5
  MAC address: 00e0.5284.0b44  Port state: UP
  IPX network:       0000ABCD  Frame type: ethernet_snap   Allow NetBIOS: NO
  rip-interval: 60  rip-max-packet-size: 432  rip-multiplier: 3
  sap-interval: 60  sap-max-packet-size: 480  sap-multiplier: 3
```

Syntax: show ipx interface [ethernet <portnum> | ve <num>]

The **ethernet** <portnum> parameter lets you specify a routing switch port.

The **ve** <num> parameter lets you specify a virtual interface (VE).

This display shows the following information.

Table 14.2: CLI Display of IPX Interface Information

This Field...	Displays...
Interface	The port or virtual interface on which the IPX interface is configured.
MAC address	The MAC address of the interface.
Port state	The state of the interface. The state can be one of the following: • DOWN • UP
IPX network	The IPX network number.
Frame type	The frame type of the network. The frame type can be one of the following: • ethernet_802.2 • ethernet_802.3 • ethernet_ii • ethernet_snap
Allow NetBIOS	Indicates whether the interface allows NetBIOS traffic. This field can have the following values: • NO • YES
rip-interval	The RIP advertisement interval. The RIP advertisement interval specifies how often the routing switch sends IPX RIP updates to neighboring IPX routers. To modify this parameter, see “Modify the RIP Advertisement Interval” on page 14-14.
rip-max-packet-size	The maximum packet size for IPX RIP updates. The default IPX RIP packet size is 432 bytes, which allows 50 routes plus 32 bytes of header in an IPX RIP update packet. To modify this parameter, see “Modify the RIP Advertisement Packet Size” on page 14-13.
rip-multiplier	The age timer for learned IPX routes. The age timer specifies how many seconds a learned IPX route can remain in the routing switch's IPX route table before aging out. To modify this parameter, see “Modify the Age Timer for Learned IPX Routes” on page 14-15.

Table 14.2: CLI Display of IPX Interface Information (Continued)

This Field...	Displays...
sap-interval	The SAP advertisement interval. The IPX SAP advertisement interval specifies how often the routing switch sends IPX SAP updates to neighboring IPX routers. To modify this parameter, see “Modify the SAP Advertisement Interval” on page 14-14.
sap-max-packet-size	The maximum packet size for IPX SAP advertisements. The default IPX SAP packet size is 480 bytes, which allows seven servers plus 32 bytes of header in an IPX SAP update packet. To modify this parameter, see “Modify the SAP Advertisement Packet Size” on page 14-13.
sap-multiplier	The age timer for learned SAP entries. The age timer specifies how many seconds a learned IPX server can remain in the routing switch's IPX service table before aging out. To modify this parameter, see “Modify the Age Timer for Learned SAP Entries” on page 14-15.

USING THE WEB MANAGEMENT INTERFACE

To display IPX interface information:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view.
3. Click on the plus sign next to IPX in the tree view to expand the list of IPX option links.
4. Click on the Interface link to display the IPX interface table.

Displaying the IPX Forwarding Cache

To display the IPX forwarding cache for the routing switch, use one of the following methods.

USING THE CLI

To display the IPX forwarding cache, enter the following command at any CLI level:

```
HP9300> show ipx cache

Total number of IPX cache entries 3

Forwarding

Index  Network   Router       Out-Filter  Frame-Type    Port
1     11110007  0000.0000.0000  off       ethernet_802.3    7
2     11110005  0000.0000.0000  off       ethernet_802.3    5
3     32D564FA  00a0.24bf.89ca  off       ethernet_802.3    5
```

Syntax: show ipx cache [<num(hex)>]

The <num(hex)> parameter lets you specify an IPX network number.

This display shows the following information.

Table 14.3: CLI Display of IPX Forwarding Cache

This Field...	Displays...
Total number of IPX cache entries	The number of entries in the forwarding cache.
Index	The row number of this entry in the cache.
Network	The network containing the destination node.
Router	The MAC address of the next-hop IPX router. If the destination is local, the address is shown as all zeros.
Out-Filter	Whether an outbound filter is configured for traffic to the destination network number or node. The value can be one of the following: • No • Yes
Frame-Type	The frame encapsulation type, which can be one of the following: • Ethernet SNAP • Ethernet 802.2 • Ethernet 802.3 • Ethernet II
Port	The port through which the routing switch sends traffic to the destination network and node.

USING THE WEB MANAGEMENT INTERFACE

To display the IPX forwarding cache:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Monitor in the tree view to display the list of monitoring options.
3. Click on the plus sign next to IPX in the tree view to expand the list of IPX option links.
4. Click on the Cache link.

Displaying the IPX Route Table

To display the IPX route table, use one of the following methods.

USING THE CLI

To display the IPX route table, enter the following command at any CLI level:

```
HP9300> show ipx route

Total number of IPX route entries 3

Forwarding

Index   Network   Router          Hops  Ticks Port
1       11110007  0000.0000.0000     0      1     7
2       32D564FA  00a0.24bf.89ca     1      2     5
3       11110005  0000.0000.0000     0      1     5
```

Syntax: show ipx route [<num(hex)>]

The <num(hex)> parameter lets you specify an IPX network number.

This display shows the following information.

Table 14.4: CLI Display of IPX Route Table

This Field...	Displays...
Total number of IPX route entries	The number of entries in the table.
Index	The index number of the table entry.
Network	The IPX network at the route's destination.
Router	The MAC address of the next-hop IPX router.
Hops	The number of hops (routers) separating the router from the network.
Ticks	The number of ticks.
Port	The port through which the routing switch sends traffic to the destination network.

USING THE WEB MANAGEMENT INTERFACE

To display the IPX route table:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Monitor in the tree view to display the list of monitoring options.
3. Click on the plus sign next to IPX in the tree view to expand the list of IPX option links.
4. Click on the Route link.

Displaying the IPX Server Table

To display the IPX server table, use one of the following methods.

USING THE CLI

To display the IPX server table, enter the following command at any CLI level:

```
HP9300> show ipx servers

Total number of IPX server entries 3

Index  Network   Node              Socket    Type      Hops
1      32D564FA  0000.0000.0001    0005      026B        1
         Server-name: HPD
2      32D564FA  0000.0000.0001    4006      0278        1
         Server-name: HPM
3      32D564FA  0000.0000.0001    0451      0004        1
         Server-name: HP-MPR2
```

Syntax: show ipx servers [<name>]

The <name> parameter lets you specify a server name.

This display shows the following information.

Table 14.5: CLI Display of IPX Server Table

This Field...	Displays...
Index	The index number of the table entry.
Network	The network in which the server is located.
Node	The six-byte node number. The node number can be a MAC address or, for some IPX server types, a “1”.
Socket	The two-byte socket number.
Type	The two-byte number for the server type.
Hops	The number of IPX router hops to the server’s network.
Server-name	The IPX server name.

USING THE WEB MANAGEMENT INTERFACE

To display the IPX server table:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Monitor in the tree view to display the list of monitoring options.
3. Click on the plus sign next to IPX in the tree view to expand the list of IPX option links.
4. Click on the Server link.

Displaying IPX Traffic Statistics

To display IPX traffic statistics, use one of the following methods.

USING THE CLI

To display IPX traffic statistics, enter the following command at any CLI level:

```
HP9300> show ipx traffic


                                             Dropped             Filtered
Port   Forward    Receive   Transmit    Receive   Transmit   Receive  Transmit
 1/5         46         36          8          2          0         0         0
 1/7          0          0          6          0          0         0         0
Tot          46         36         14          2          0         0         0
```

Syntax: show ipx traffic

This display shows the following information.

Table 14.6: CLI Display of IPX Traffic Statistics

This Field...	Displays...
Port	The port for which the statistics apply. Only the ports that have IPX interfaces configured on them are listed.
Forward	The number of IPX packets received by the routing switch from another device and then sent on the port.
Receive	The number of IPX packets received on the port.
Transmit	The number of IPX packets originated on the routing switch and sent on the port.
Dropped Receive	The number of packets received on this port by the routing switch that the routing switch dropped.
Dropped Transmit	The number of packets queued for sending on this port by the routing switch but then dropped.
Filtered Receive	The number of packets received by this port that matched an inbound IPX filter configured on the port.
Filtered Transmit	The number of packets queued for sending on this port that matched an outbound IPX filter configured on the port.

USING THE WEB MANAGEMENT INTERFACE

To display summary IPX traffic statistics:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Monitor in the tree view to display the list of monitoring options.
3. Click on the plus sign next to IPX in the tree view to expand the list of IPX option links.
4. Click on the Traffic link.

This display shows the following information.

Table 14.7: Web Display of IPX Traffic Statistics

This Field...	Displays...
In Packets	The number of IPX packets received on the routing switch.
Out Packets	The number of IPX packets originated on the routing switch and sent on the routing switch.
Forwarding Packets	The number of IPX packets received by the routing switch from another device and then sent on the routing switch.
Rcv Drop Packets	The number of packets received by the routing switch that the routing switch dropped.
Tx Drop Packets	The number of packets queued for sending by the routing switch but then dropped.

Table 14.7: Web Display of IPX Traffic Statistics (Continued)

This Field...	Displays...
Rcv Filter Packets	The number of packets received by the routing switch that matched an inbound IPX filter.
Tx Filter Packets	The number of packets queued for sending that matched an outbound IPX filter.

To display traffic statistics for each port or virtual interface on which an IPX interface is configured:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Monitor in the tree view to display the list of monitoring options.
3. Click on the plus sign next to IPX in the tree view to expand the list of IPX option links.
4. Click on the Port Counter link.

This display shows the following information.

Table 14.8: Web Display of IPX Port Statistics

This Field...	Displays...
Port	The port or virtual interface on which the IPX interface is configured.
Forward Packets	The number of IPX packets received by the routing switch from another device and then sent on the port.
Rcv Packets	The number of IPX packets received on the port.
Tx Packets	The number of IPX packets originated on the routing switch and sent on the port.
Rcv Drop Packets	The number of packets received on this port by the routing switch that the routing switch dropped.
Tx Drop Packets	The number of packets queued for sending on this port by the routing switch but then dropped.
Rcv Filter Packets	The number of packets received by this port that matched an inbound IPX filter configured on the port.
Tx Filter Packets	The number of packets queued for sending on this port that matched an outbound IPX filter configured on the port.

Chapter 15
Configuring AppleTalk

This chapter describes how to configure AppleTalk on HP 9304M, HP 9308M, and HP 6308M-SX routing switches using the CLI and the Web management interface. The routing switches support Phase II of AppleTalk routing.

For complete syntax information for the CLI commands shown in this chapter, see the *Command Line Interface Reference*.

NOTE: In addition to the routing features described in this chapter, the routing switches support AppleTalk cable VLANs. If you configure multiple cable VLANs, the routing switch bridges traffic within a VLAN and routes traffic between VLANs. See "Configuring AppleTalk Cable VLANs" on page 16-29.

Overview of AppleTalk

AppleTalk inter-networks are built upon distinct networks interconnected by routers. Each network is composed of nodes—workstations, printers, and servers. AppleTalk zones are assigned across AppleTalk networks to further define end-user access to shared resources such as printers and servers.

Address Assignment

AppleTalk node addresses are assigned dynamically. When a Macintosh running AppleTalk starts up, it selects a network address and checks to see if that address is already in use. If the address is already in use by another client, a message will be returned to the requesting station and the process will repeat until an uncommitted address is located.

Network Components

Nodes

The ***node*** is the primary building block of any AppleTalk network. A node is any device on an AppleTalk network such as a workstation, printer, or server running AppleTalk.

Networks

Multiple nodes that share the same logical segment comprise an AppleTalk network. Each node in the network is assigned an AppleTalk address.

An AppleTalk address is comprised of a 16-bit network number and an 8-bit node number. For example, 500.50 refers to node 50 on network 500.

An AppleTalk network address is a single 16-bit network number or a network range (cable range). The network range specifies a range of contiguous network numbers with start and end values.

Zones

AppleTalk zones are logical groupings of AppleTalk nodes defined within and across multiple networks as shown in Figure 15.1. For example, the Finance zone comprises two separate networks, 500 and 600. These network numbers are assigned to a specific interface on a router, and nodes within those networks are automatically assigned numbers in that range.

Defining zones for certain workstations and resources on the network allows you to easily permit or deny access to certain devices or information on the network by providing or hiding information about zones to a node or network. This is further explained in the following sections on filtering.

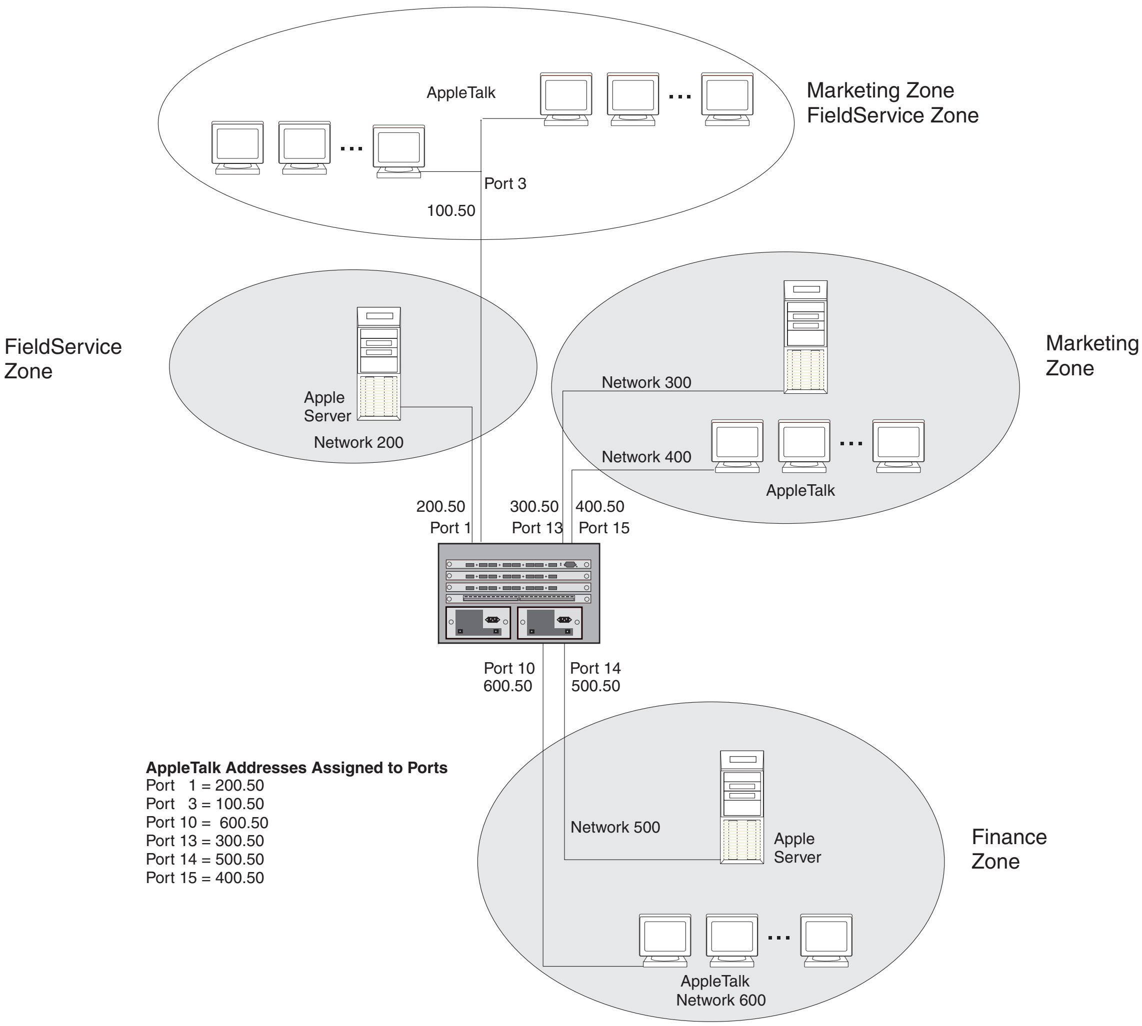


Figure 15.1 AppleTalk Zones defined within and across AppleTalk networks

Zone Filtering

Zone filtering allows you to define access for a network and its nodes by defining single permit or deny filters, rather than defining an access list for each node independently.

By eliminating the need to enter separate numbers for each device or network segment, zone filters improve overall system administration of an AppleTalk network. For example, if a new device such as a server or laser printer is added to an existing zone, all users in that zone automatically have access to that device without any additional configuration.

Additionally, this feature helps eliminate unauthorized access to devices within restricted zones. As new devices are added to secured zones, information on those devices is protected automatically.

Network Filtering

You also can filter on a network basis by enabling the Routing Table Maintenance Protocol (RTMP) filtering capability of zone filtering. When this filter is enabled on an interface, the denied network numbers are removed from the RTMP packet before it is transmitted out of the interface.

You can define deny or permit zone and network filters for AppleTalk on an interface basis. You can define up to 32 filters for routing switches operating with 32MB of memory. For those systems with 8MB of memory installed, you can define up to 16 filters.

Seed and Non-Seed Routers

An AppleTalk router must be configured as either a seed or a non-seed router.

When you configure an AppleTalk router as a seed router, you must define the cable-range, address, and zone names for the router. When you configure a non-seed router, the router will learn its parameters from a seed AppleTalk router on the same segment.

AppleTalk Components Supported on the HP 9304M, HP 9308M, and HP 6308M-SX Routing Switches

The following sections describe the AppleTalk protocol components supported by the HP 9304M, HP 9308M, and HP 6308M-SX routing switches.

Session Layer Support

The ***Zone Information Protocol (ZIP)*** maintains the mapping between defined network numbers and zone names within an AppleTalk network. This information is stored on a router in the zone information table.

ZIP also uses information from the RTMP routing table to stay current on the network topology.

Transport Layer Support

Routing Table Maintenance Protocol (RTMP)

RTMP establishes and maintains the AppleTalk routing table. AppleTalk routers use RTMP to exchange routing information at regular intervals to ensure that each router has the latest routing information.

The periodic updates are sent out every 10 seconds by default.

AppleTalk Echo Protocol (AEP)

AppleTalk routers use AEP to check connectivity to other devices on the network.

AppleTalk Transaction Protocol (ATP)

ATP facilitates transaction-based applications. ATP supports a client/server design in which clients request information and servers reply with a response to that request. The protocol assigns a transaction ID to each request/response pair and allows only one instance of that specific transaction.

A sub-set of ATP is implemented to support ZIP on the HP 9304M, HP 9308M, and HP 6308M-SX routing switches.

Name Binding Protocol (NBP)

NBP maps AppleTalk names used on a network with addresses. For example, a printer for the marketing group may be named MKTG with an address of 100.5. This association is mapped together by the NBP.

NBP is dynamically initiated when the node is started. NBP also addresses registration, deletion, confirmation, and search of names.

Network Layer Support

Datagram Delivery Protocol (DDP)

DDP provides connectionless service between application sockets on an AppleTalk network and administers AppleTalk addresses.

AppleTalk Address Resolution Protocol (AARP)

AARP translates AppleTalk addresses into 48-bit data link addresses. The 48-bit data link address is required in order to send AppleTalk packets to a specific node. AARP is also used to check for duplicate AppleTalk addresses on the network.

An AARP entry notes the mapping between a node's AppleTalk address and its MAC (hardware) address.

Data Link Support

AppleTalk supports the ***EtherTalk Link Access Protocol (ELAP)***, which defines the layer 2 encapsulation for AppleTalk packets.

Dynamic AppleTalk Activation and Configuration

AppleTalk is automatically activated when you enable the protocol on systems running software release 4.0 or later. On platforms running an earlier software release, you must reset the system to initially enable AppleTalk; however, all changes after that occur dynamically.

Configuring AppleTalk Routing

To begin using AppleTalk on a routing switch, perform the following tasks:

1. Enable AppleTalk on the routing switch, if it is not already enabled.
2. Configure AppleTalk as either a seed or a non-seed router.

   When you configure a seed router, you define the cable-range, address, and zone names for the router. When you configure a non-seed router, the router will learn its parameters from another AppleTalk router on the same segment.
3. Define zone and additional zone filters, if desired.
4. Configure virtual interfaces to allow routing between AppleTalk VLANs, if desired.
5. Modify global parameters, if desired.

Enable AppleTalk

To enable AppleTalk routing on a routing switch, use one of the following methods.

NOTE: Once AppleTalk is enabled at the global (system) level, no additional configuration is required at this level unless the default parameters assigned need to be modified to address network requirements. See "Modifying AppleTalk Global Parameters" on page 15-16.

USING THE CLI

```
HP9300(config)# router appletalk
HP9300(config)# write memory
HP9300(config)# end
```

Syntax: router appletalk

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Select the Enable radio button next to AppleTalk.
3. Click the Apply button to apply the changes to the device's running-config file.
4. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring a Seed AppleTalk Router

When you configure an AppleTalk router as a seed router, you must define the cable range, AppleTalk address, and zone names for the router interfaces.

To configure a seed router, perform the following tasks:

1. Configure the cable range (network numbers) to be supported on that interface.
2. Assign an AppleTalk address to the interface.
3. Assign a zone or zones to the interface.
4. Enable AppleTalk routing on the interface.

NOTE: Before configuring interface parameters for AppleTalk, you must enable AppleTalk at the system level.

USING THE CLI

This section describes defining a cable range, assigning network addresses and zones, and enabling AppleTalk routing on an interface.

Configuring the Cable Range for an Interface

To support network numbers from 10 – 50 on interface 1/3, enter the following commands:

```
HP9300(config)# int e 1/3
HP9300(config-if-1/3)# appletalk cable 10 - 50
```

Syntax: appletalk cable <network-number> | <network-number – network-number>

Configuring a Network Address for an Interface

To assign an AppleTalk address of 10.5 to interface 1/3, enter the following command:

```
HP9300(config-if-3)# appletalk address 10.5
```

Syntax: appletalk address <node.network>

Configuring Zones on an Interface

To assign sales, marketing, and finance zones for interface 1/3, enter the following commands:

```
HP9300(config-if-1/3)# appletalk zone sales
HP9300(config-if-1/3)# appletalk zone marketing
HP9300(config-if-1/3)# appletalk zone finance
```

NOTE: You can configure up to 1536 zones on a routing switch.

Enabling AppleTalk Routing on an Interface

To enable AppleTalk routing on interface 1/3, enter the following command:

```
HP9300(config-if-1/3)# appletalk routing
```

Saving Configuration Changes to the Interface

Once you have configured the cable range, network address, zone(s), and AppleTalk routing for an interface, you can preserve the configuration changes by saving them to flash.

```
HP9300(config-if-1/3)# write memory
HP9300(config-if-1/3)# end
HP9300# reload
```

NOTE: When there is more than one seed router on the network, make sure the AppleTalk configuration of each of those seed routers is consistent with other routers on the same segment.

USING THE WEB MANAGEMENT INTERFACE

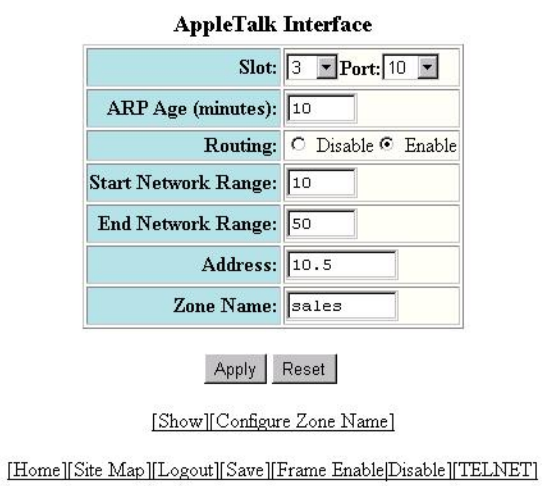
This section describes how to enable AppleTalk on the routing switch as well as how to configure the cable range, network address, and zones for an AppleTalk seed router.

To enable AppleTalk on the routing switch:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Select the Enable radio button next to AppleTalk.
3. Click the Apply button to apply the changes to the device's running-config file.
4. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

To configure an interface as a seed router:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to AppleTalk in the tree view to expand the list of AppleTalk option links.
4. Click on the Interface link to display the AppleTalk Interface table.
5. Click on the Modify button next to the interface you want to configure for AppleTalk. The AppleTalk Interface configuration panel is displayed, as shown in the following example.



6. Select the port or slot/port to be configured from the port pulldown menu(s).
7. Modify the ARP age value from the default value of 10 minutes, if desired. Possible values are 1 – 240 minutes.

8. Beginning in software release 06.x, the AppleTalk ARP age is a global parameter instead of an interface parameter. When you enter an ARP age value for a port and apply the change to the running-config file or save the change to the startup-config file, the change is saved as the global setting. If you try to set different values for different ports, the interface does not display an error message. Instead, the most recent value you enter before saving the configuration change becomes the global setting.
9. Enable the routing option.
10. Configure the range of supported network addresses by entering the lowest supported number in the Start Network Range field and the highest supported number in the End Network Range field.
11. Enter the AppleTalk address for the port. The address should be a two decimal number, and the first number should be within the network range entered in step 10 above.
12. Enter a zone name for the port.

NOTE: To enter multiple zone names for a port, select the Configure Zone Name link at the bottom of the entry panel. A separate entry panel for that interface will appear. Enter the name(s) of the other zone(s) on an individual basis, selecting the Add button after each entry. For this example, a summary panel shows the resulting configuration (Figure 15.3).

NOTE: If you do not enter any values other than zero in the network range or address field, and the zone name field is empty, the router will be a non-seed router.

13. Click the Apply button to apply the changes to the device's running-config file.
14. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring a Non-seed AppleTalk Router

This section describes how to configure a non-seed router using the CLI or the Web management interface.

To configure a non-seed router, perform the following tasks:

1. Verify that at least one AppleTalk router in the network of the routing switch being configured is operating as a seed router.

NOTE: This requirement ensures that the non-seed router has a seed router on the same segment, from which it can learn configuration details.

2. Enable AppleTalk at the global level.
3. Enable AppleTalk routing on the interface(s).

Enabling AppleTalk Routing at the Global (System) Level

To enable AppleTalk on the routing switch, use one of the following methods:

USING THE CLI

```
HP9300(config)# router appletalk
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Select the Enable radio button next to AppleTalk.
3. Click the Apply button to apply the changes to the device's running-config file.
4. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Enable AppleTalk Routing on an Interface

To enable AppleTalk on interface 1/5, use one of the following methods.

USING THE CLI

```
HP9300(config)# int e 1/5
HP9300(config-if-1/5)# appletalk routing
HP9300(config-if-1/5)# end
HP9300# write memory
HP9300# reload
```

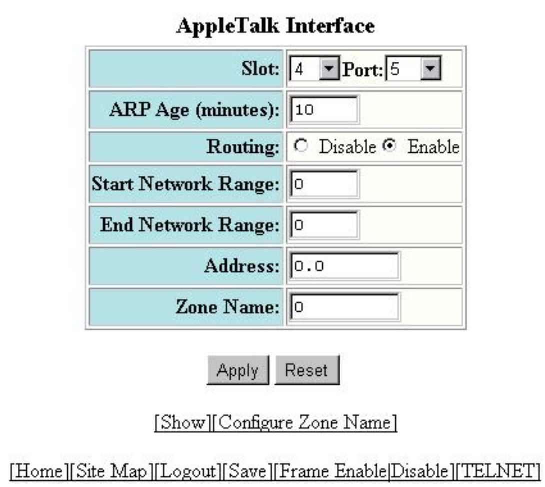
NOTE: By definition, values for the network range, AppleTalk address, and zone name fields are never entered for a non-seed router. If you enter information into these fields, the routing switch is a seed router.

NOTE: Once configured as a non-seed router, the routing switch will send out a query to a seed router on its network to obtain configuration details such as network range, AppleTalk address, and zone name(s) for the routing switch.

USING THE WEB MANAGEMENT INTERFACE

To configure an interface as a non-seed router:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to AppleTalk in the tree view to expand the list of AppleTalk option links.
4. Click on the Interface link to display the AppleTalk Interface table.
5. Click on the Modify button next to the interface you want to configure for AppleTalk. The AppleTalk Interface configuration panel is displayed, as shown in the following example.



6. Select the port or slot/port to be configured from the port pulldown menu(s).
7. Modify the ARP age value from the default value of 10 minutes, if desired. Possible values are 1 – 240 minutes.

8. Beginning in software release 06.x, the AppleTalk ARP age is a global parameter instead of an interface parameter. When you enter an ARP age value for a port and apply the change to the running-config file or save the change to the startup-config file, the change is saved as the global setting. If you try to set different values for different ports, the interface does not display an error message. Instead, the most recent value you enter before saving the configuration change becomes the global setting.
9. Enable the routing option.
10. Click the Apply button to apply the changes to the device's running-config file.
11. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying AppleTalk Interface Configurations

Once AppleTalk is active on a routing switch, all configuration changes are dynamic and require no reset. However, once you configure an interface for AppleTalk, you must disable AppleTalk routing before you can make any changes to the cable range, network address, or zones values. Once you make changes, you then must re-enable AppleTalk routing for the new changes to take effect.

EXAMPLE:

Suppose you want to expand the network numbers supported on interface 3 from the range 10 – 50 to the range 10 – 100. Additionally, you want to add engineering and human resource zones to the interface. To do so, use one of the following methods.

USING THE CLI

```
HP9300(config)# int e1/3
HP9300(config-if-1/3)# no appletalk routing
HP9300(config-if-1/3)# appletalk cable 10-100
HP9300(config-if-1/3)# appletalk zone engineering
HP9300(config-if-1/3)# appletalk zone humanresource
HP9300(config-if-1/3)# appletalk routing
HP9300(config-if-1/3)# end
HP9300# write memory
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to AppleTalk in the tree view to expand the list of AppleTalk option links.
4. Click on the Interface link to display the AppleTalk Interface table.
5. Click on the Modify button next to the interface you want to reconfigure for AppleTalk. The AppleTalk Interface configuration panel is displayed.
6. Modify parameters as needed.
7. To modify other interfaces, select the port (and lost number if applicable) from the Port and Slot fields, then modify the values.
8. Click the Apply button to apply the changes to the device's running-config file.
9. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Filtering AppleTalk Zones and Networks

Defining Zone Filters

Zone filtering allows you to define access for a network and its nodes by entering single permit or deny CLI commands, instead of defining an access list for each node independently.

By eliminating the need to enter separate numbers for each device or network segment, zone filters improve overall system administration of an AppleTalk network. For example, if a new device such as a server or laser printer is added to an existing zone, all users in that zone automatically have access to that device without any additional configuration.

Additionally, zone filters help eliminate unauthorized access to devices within restricted zones. As new devices are added to secured zones, information on those devices is protected automatically.

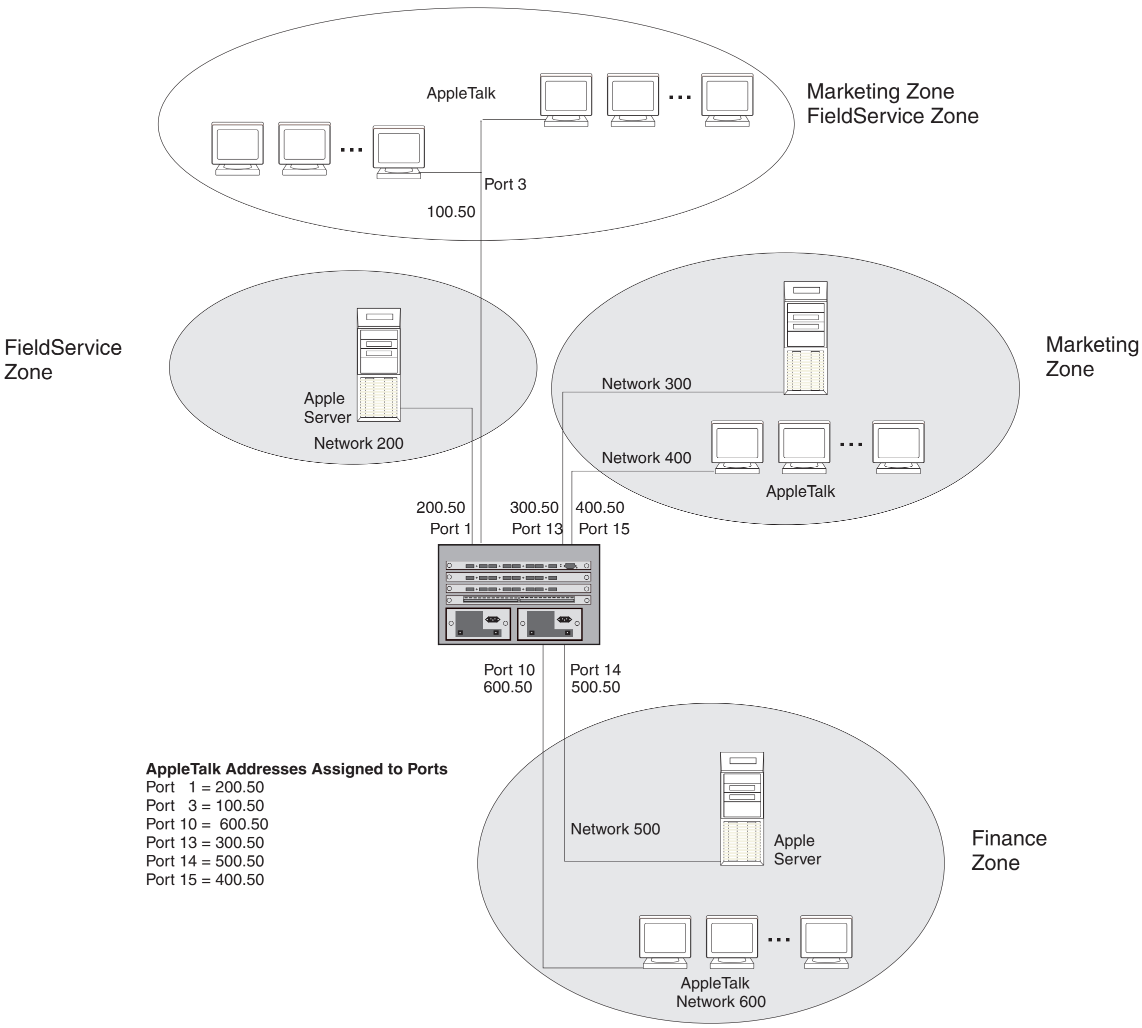


Figure 15.2 AppleTalk zones in a network

EXAMPLE:

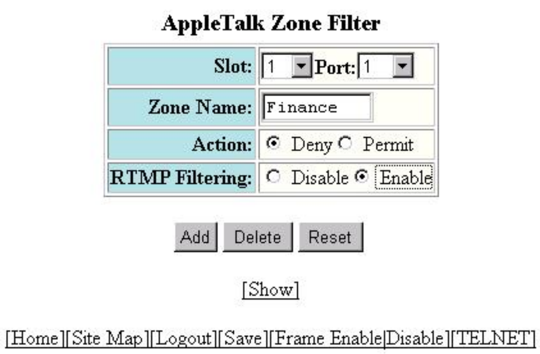
Suppose you want to deny access to the Finance server to users within the Marketing and Field Service zones on the network, as shown in Figure 15.2. To define a zone filter for this, use one of the following methods.

USING THE CLI

```
HP9300(config)# interface e1/1
HP9300(config-if-1/1)# appletalk deny zone finance
HP9300(config-if-1/1)# int e1/3
HP9300(config-if-1/3)# appletalk deny zone finance
HP9300(config-if-1/3)# int e1/13
HP9300(config-if-1/13)# appletalk deny zone finance
HP9300(config-if-1/13)# int e1/15
HP9300(config-if-1/15)# appletalk deny zone finance
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to AppleTalk in the tree view to expand the list of AppleTalk option links.
4. Click on the Zone Filter link.
   - If the device does not have any AppleTalk zone filters, the AppleTalk Zone Filter configuration panel is displayed, as shown in the following example.
   - If an AppleTalk zone filter is already configured and you are adding a new one, click on the Configure AppleTalk Zone Filter link to display the AppleTalk Zone Filter configuration panel, as shown in the following example.
   - If you are modifying an existing AppleTalk zone filter, click on the Modify button to the right of the row describing the filter to display the AppleTalk Zone Filter configuration panel, as shown in the following example.



5. Select the interface for which a zone filter is to be defined, from the port or slot/port pull down menu(s). In this example, you are defining a zone filter for interfaces 1, 3, 13, and 15, all of which have membership in either or both of the Marketing and Field Service zones.
6. Enter the name of the zone to which you are permitting or denying access. In this case, enter Finance.
7. Select either Deny or Permit. In this example, select Deny for interfaces 1, 3, 13, and 15.
8. Enable RTMP filtering to filter on a network basis. When RTMP filtering is enabled on an interface, the denied network numbers are removed from the RTMP packet before it is transmitted out of the interface.
9. Click the Apply button to apply the changes to the device's running-config file.
10. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Define Additional Zone Filters

When defining AppleTalk zone filters, you must define both deny and permit relationships for an interface. For instance, in the previous example, a deny filter prevents users within Marketing and Field Service zones from accessing the Finance zone.

Because all additional zones not specifically addressed by a deny filter are permitted by default, you do not need to configure any specific permit definitions, and the requirement of defining both deny and permit relationships is satisfied.

However, the additional zone filter is useful in denying access to those zones not specifically addressed in permit zone filters. Consider the following example.

EXAMPLE:

Suppose Sales, Human Resources (HR), Engineering, and Training zones will be added to the network in the next month. You know in advance that the only other zone that will be allowed access to the Finance zone is the HR zone.

You can configure permit zone filters (Figure 15.2) for ports 4/10 and 4/14 that allow the HR zone to have access to the finance zone and deny access to all others with a deny additional zone filter (Figure 15.2). This approach addresses the current network and all future zone additions with no additional configuration.

USING THE CLI

To define the permit filter for HR on ports 4/10 and 4/14, enter the following commands:

```
HP9300(config)# interface e 4/10
HP9300(config-if-4/10)# no appletalk routing
HP9300(config-if-4/10)# appletalk permit zone HR
HP9300(config-if-4/10)# deny additional-zones
HP9300(config-if-4/10)# appletalk routing
HP9300(config-if-4/10)# int e 4/14
HP9300(config-if-4/14)# no appletalk routing
HP9300(config-if-4/14)# appletalk permit zone HR
HP9300(config-if-4/14)# appletalk routing
HP9300(config-if-4/14)# write memory
```

NOTE: You must disable AppleTalk routing on any interface already operating with AppleTalk before making any modifications to the configuration, and then re-enable routing to activate the change.

USING THE WEB MANAGEMENT INTERFACE

To define the permit and deny filters discussed above:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to AppleTalk in the tree view to expand the list of AppleTalk option links.
4. Click on the Zone Filter link.
   - If the device does not have any AppleTalk zone filters, the AppleTalk Zone Filter configuration panel is displayed.
   - If an AppleTalk zone filter is already configured and you are adding a new one, click on the Configure AppleTalk Zone Filter link to display the AppleTalk Zone Filter configuration panel.
   - If you are modifying an existing AppleTalk zone filter, click on the Modify button to the right of the row describing the filter to display the AppleTalk Zone Filter configuration panel.

5. Select the interface for which the zone filter is to be defined from the port or slot/port pull down menu(s). In this example, you are defining a permit zone filter for HR for interfaces 10 and 14, which have membership in the Finance zone.
6. Enter the zone name to which access is to be permitted or denied. In this case, the zone name is HR.
7. Select either Deny or Permit. In this example, select Permit for interfaces 10 and 14.
8. Enable RTMP filtering to also filter on a network basis.

NOTE: When this filter is enabled on an interface, the denied network numbers are removed from the RTMP packet before it is transmitted out of the interface. In this example, RTMP filtering is not desired, so this option default is left as disabled.

9. Click the Apply button to apply the changes to the device's running-config file.
10. Click on the Additional Zone Filter link in the tree view.
11. Select the interface for which the zone filter is to be defined, from the port or slot/port pull down menu(s). In this example, define a deny zone filter for interfaces 10 and 14 to deny all other zones not specified in the permit zone filter (steps 1 – 6 above).
12. Select either Deny or Permit. For this example, select Deny for interfaces 10 and 14.
13. Disable RTMP filtering.
14. Click the Apply button to apply the changes to the device's running-config file.
15. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Network Filtering

EXAMPLE:

To deny access to the Finance server to users within the Marketing and Field Service zones on the network and to prevent information about the zone and the network numbers from being forwarded out of interface 1/1 (Figure 15.2), use one of the following methods.

USING THE CLI

```
HP9300(config-if-1/1)# appletalk deny zone finance rtmp-filtering
```

USING THE WEB MANAGEMENT INTERFACE

To enable RTMP filtering on an interface, define the filter as usual, then enable the RTMP filtering option on the AppleTalk Zone Filter panel.

Routing Between AppleTalk VLANs Using Virtual Interfaces

In addition to supporting AppleTalk VLANs, the routing switches support routing between AppleTalk VLANs using virtual interfaces. The virtual interfaces provide VLANs access to the router functions of routing switches. Using these virtual interfaces eliminates the need to assign a physical port for routing between local VLANs.

AppleTalk routing between virtual and physical interfaces is also supported.

EXAMPLE:

In Figure 15.3, AppleTalk traffic is terminating on ports 1/1 through 1/4. Suppose you want to group all of these interfaces into an AppleTalk protocol VLAN and route traffic to VLANs on other routing switches.

To do so, perform the following steps:

1. Create an AppleTalk protocol VLAN with port membership of ports 1, 2, 3, and 4.
2. Assign a virtual interface to the AppleTalk VLAN to allow it to route traffic to AppleTalk VLANs on remote routing switches.

3. Configure a physical interface on the routing switch that provides access to remote networks to support routing between local and remote AppleTalk VLANs.

NOTE: By supporting assignment of VLANs on interfaces, the routing switch is functioning as a virtual switch.

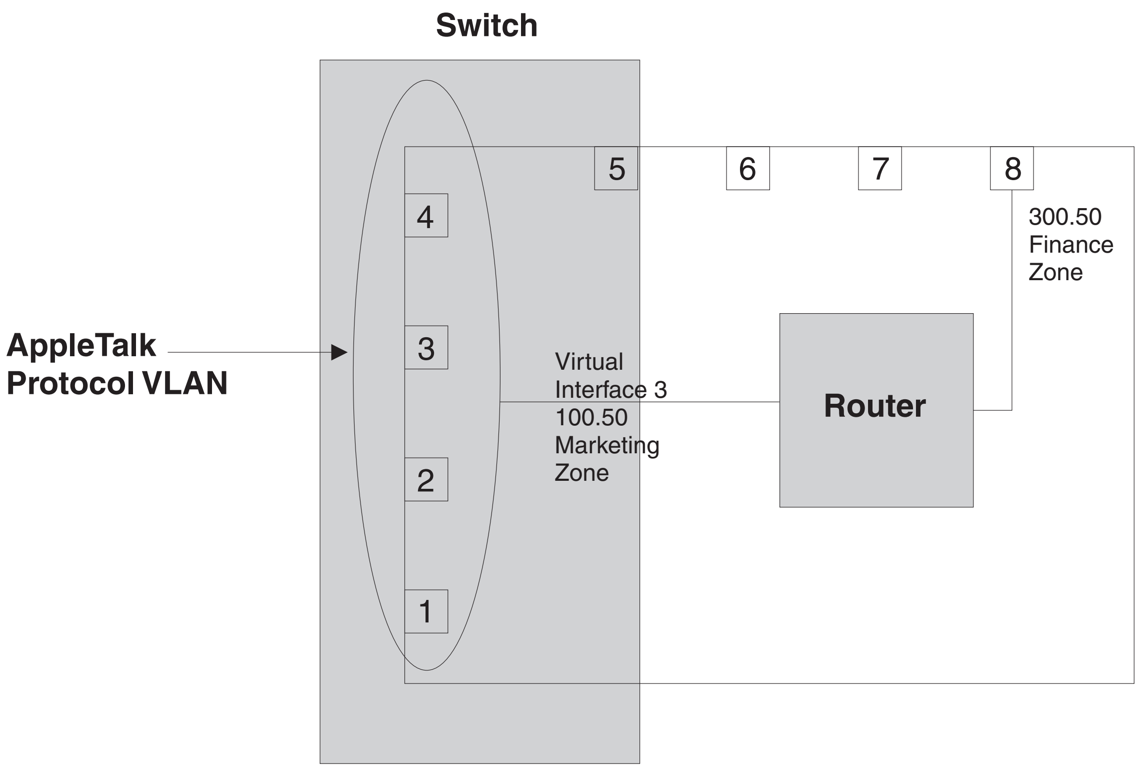


Figure 15.3 Virtual interface provides a routing interface to an AppleTalk VLAN

USING THE CLI

To configure the AppleTalk VLAN as seen in Figure 15.3, enter the following commands:

```
HP9300(config)# router appletalk
HP9300(config)# vlan 1
HP9300(config-vlan-1)# atalk-proto
HP9300(config-vlan-atalk-proto)# static e1/1 to 1/4
HP9300(config-vlan-atalk-proto)# router-interface ve 3
```

To configure the physical interface (e 1/8) to which all outgoing traffic is forwarded, enter the following commands:

```
HP9300(config-vlan-atalk-proto)# int e1/8
HP9300(config-if-1/8)# appletalk cable-range 300 - 300
HP9300(config-if-1/8)# appletalk address 300.50
HP9300(config-if-1/8)# appletalk zone-name Finance
HP9300(config-if-1/8)# appletalk routing
```

To configure the defined AppleTalk VLAN virtual interface ve3, enter the following commands:

```
HP9300(config-if-1/8)# int ve 3
HP9300(config-vif-3)# appletalk cable-range 100 - 100
HP9300(config-vif-3)# appletalk address 100.50
HP9300(config-vif-3)# appletalk zone-name Marketing
HP9300(config-vif-3)# appletalk routing
```

Routing Between Protocol VLANs Within Port-Based VLANs

In Figure 15.4, AppleTalk traffic is terminating on ports 1 – 4 on two separate networks, 100 and 200. Suppose you want to assign these networks to two separate VLANs but would also like to route traffic between the two VLANs and externally to the routing switch.

To create the configuration shown in Figure 15.4, perform the following tasks.

1. Create port-based VLANs 2 and 3.

NOTE: Protocol VLANs must always be within the boundaries of a port-based domain. Whenever port and protocol VLANs operate on a system together, you must create the port-based VLAN before you create the protocol VLAN. The protocol-based VLAN overlays the port-based VLAN.

2. Create AppleTalk protocol VLANs 2 and 3.
3. Configure router interfaces virtual 3 (v3) and virtual 5 (v5).
4. Configure physical interface port 8.

NOTE: Each of the above tasks is described in the following sections.

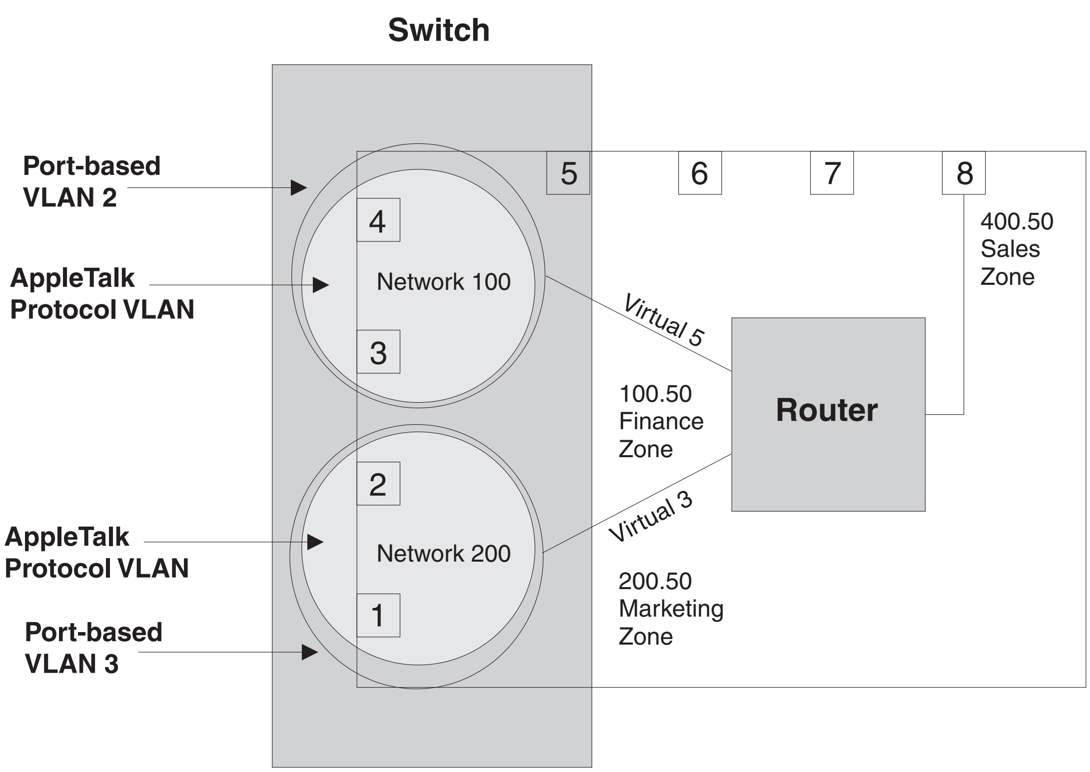


Figure 15.4 Routing between AppleTalk VLANs

USNG THE CLI

```
HP9300(config)# vlan 2 by port
HP9300(config-vlan-2)# untag e1/3 to 1/4
HP9300(config-vlan-2)# atalk-proto
HP9300(config-vlan-atalk-proto)# static e1/3 to 1/4
HP9300(config-vlan-atalk-proto)# router-interface ve 5
HP9300(config-vlan-atalk-proto)# end
HP9300(config-vlan-2)# vlan 3 by port
HP9300(config-vlan-3)# untag e1/1 to 1/2
HP9300(config-vlan-3)# atalk-proto
HP9300(config-vlan-atalk-proto)# router-interface ve 3
```

To configure the physical interface (e8) to which all outgoing traffic is forwarded, enter the following commands:

```
HP9300(config-vlan-atalk-proto)# int e1/8
HP9300(config-if-1/8)# appletalk cable-range 400 - 400
HP9300(config-if-1/8)# appletalk address 400.50
HP9300(config-if-1/8)# appletalk zone-name sales
HP9300(config-if-1/8)# appletalk routing
```

To configure the defined AppleTalk VLAN virtual interfaces ve3 and ve5, enter the following commands:

```
HP9300(config-if-1/8)# int ve 5
HP9300(config-vif-5)# appletalk cable-range 100 - 100
HP9300(config-vif-5)# appletalk address 100.50
HP9300(config-vif-5)# appletalk zone-name finance
HP9300(config-vif-5)# appletalk routing
HP9300(config-vif-5)# int ve 3
HP9300(config-vif-3)# appletalk cable-range 200 - 200
HP9300(config-vif-3)# appletalk address 200.50
HP9300(config-vif-3)# appletalk zone-name marketing
HP9300(config-vif-3)# appletalk routing
HP9300(config-vif-3)# end
HP9300# write memory
```

Modifying AppleTalk Global Parameters

You can modify the following AppleTalk parameters at the global level:

- AppleTalk ARP age
- AppleTalk ARP retransmission count
- AppleTalk ARP retransmission interval
- AppleTalk glean packets
- AppleTalk QoS socket (assigns a higher priority)

- AppleTalk RTMP update interval
- AppleTalk ZIP query interval

The following sections describe these parameters and show how to change them.

AppleTalk ARP Age

To change the AppleTalk ARP age in software release 06.*X* or later, use one of the following methods.

USING THE CLI

To change the AppleTalk ARP age, enter the following command at any level of the CLI:

```
HP9300(config)# appletalk arp 30
HP9300(config)# write memory
```

Syntax: [no] appletalk arp-age <num>

The <num> parameter specifies the number of minutes for the ARP age and can be from 1 – 240. The default is 10.

USING THE WEB MANAGEMENT INTERFACE

You can change the AppleTalk ARP age using the Web management interface, but the interface still allows you to enter the ARP age value only on an individual port basis. However, when you enter an ARP age value for a port and apply the change to the running-config file or save the change to the startup-config file, the change is saved as the global setting. If you try to set different values for different ports, the interface does not display an error message. Instead, the most recent value you enter before saving the configuration change becomes the global setting.

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled AppleTalk, enable it by clicking on the Enable radio button next to AppleTalk on the System configuration dialog, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to AppleTalk in the tree view to expand the list of AppleTalk option links.
5. Click on the Interface link to display the AppleTalk Interface table.
6. Click on the Modify button to the right of any port listed in the table to display the AppleTalk Interface configuration panel. Regardless of the port you choose, the setting will take effect globally.
7. Edit the value in the ARP Age field to the new ARP age. You can enter a value from 1 – 240 minutes. The default is 10 minutes.
8. Click the Apply button to apply the change to the device’s running-config file.
9. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

AppleTalk ARP Retransmit Count

You can modify the maximum number of times that a packet will be sent out for ARP cache informational updates. The packet is sent out to the maximum amount defined, until the information is received.

If no response is received before the count number expires, the routing switch does not send any additional packets. Possible values are from 1 – 10. The default is 2.

EXAMPLE:

To modify the number of times packet requests are sent out for ARP updates from the default (2) to 8, use one of the following methods.

USING THE CLI

```
HP9300(config)# appletalk arp retransmit-count 8
```

Syntax: appletalk arp retransmit-count <1-10>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to AppleTalk in the tree view to expand the list of AppleTalk option links.
4. Click on the General link to display the AppleTalk configuration panel.
5. Enter a new ARP retransmit count from 1 – 10 in the ARP Retransmit Count field. For this example, enter 8.
6. Click the Apply button to apply the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory

NOTE: You also can access the dialog for saving configuration changes by clicking on Command in the tree view, then clicking on Save to Flash.

AppleTalk ARP Retransmit Interval

You can modify the interval between the transmission of ARP packets. Possible values are from 1 – 120 seconds. The default is 1 second.

EXAMPLE:

To modify the ARP retransmission interval from the default value (1) to 15 seconds, use one of the following methods.

USING THE CLI

```
HP9300(config)# appletalk arp retransmit-interval 15
```

Syntax: appletalk arp retransmit-interval <1-120>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to AppleTalk in the tree view to expand the list of AppleTalk option links.
4. Click on the General link to display the AppleTalk configuration panel.
5. Enter a new AppleTalk ARP Retransmit Interval from 1 – 120 in the ARP Retransmit Interval field. For this example, enter 15.
6. Click the Apply button to apply the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

AppleTalk Glean Packets

When you enable the glean packet parameter on an AppleTalk router, the router tries to learn the MAC address from the packet instead of sending out an ARP request. The glean packets parameter is disabled by default.

EXAMPLE:

To enable glean packets, use one of the following methods.

USING THE CLI

```
HP9300(config)# appletalk glean-packets
```

Syntax: appletalk glean-packets

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to AppleTalk in the tree view to expand the list of AppleTalk option links.
4. Click on the General link to display the AppleTalk configuration panel.
5. Select Enable next to Glean Packet.
6. Click the Apply button to apply the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

AppleTalk QoS Socket

The user can use the QoS socket parameter to assign a higher priority to specific AppleTalk sockets. Possible values are 0 (normal priority) to 7 (highest priority). The default value for all sockets is 0.

For more information and procedures, see "Assigning AppleTalk Sockets to Priority Queues" on page 2-25.

AppleTalk RTMP Update Interval

You can change the RTMP update interval to modify how often the routing switch sends RTMP updates on AppleTalk interfaces. Possible values are from 1 – 3600 seconds. The default is 10 seconds.

EXAMPLE:

To change the value to 50 seconds from a default value of 10 seconds, use one of the following methods.

USING THE CLI

```
HP9300(config)# appletalk rtmp-update-interval 50
```

Syntax: appletalk rtmp-update-interval <1-3600>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to AppleTalk in the tree view to expand the list of AppleTalk option links.
4. Click on the General link to display the AppleTalk configuration panel.
5. Enter a new RTMP update interval from 1 – 3600 in the RTMP Update Interval field. For this example, enter 50.
6. Click the Apply button to apply the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

AppleTalk ZIP Query Interval

You can change the ZIP query interval to modify how often the routing switch retransmits ZIP query messages. Possible values are from 1 – 1000 seconds. The default is 10 seconds.

EXAMPLE:

To change the ZIP query interval to 30 seconds from the default value (10 seconds), use one of the following methods.

USING THE CLI

```
HP9300(config)# appletalk zip-query-interval 30
```

Syntax: appletalk zip-query <1-1000>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to AppleTalk in the tree view to expand the list of AppleTalk option links.
4. Click on the General link to display the AppleTalk configuration panel.
5. Enter a new ZIP query interval from 1 – 1000 in the ZIP Query Interval field. For this example, enter 30.
6. Click the Apply button to apply the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Displaying AppleTalk Information

You can use the CLI or the Web management interface to display configuration information and statistics for AppleTalk.

USING THE CLI

When using the CLI, you can access information about AppleTalk by entering the following **show** commands.

NOTE: For more details on these commands, see the *Command Line Interface Reference*.

- **show appletalk arp cache**: Displays the ARP table for the AppleTalk routing protocol.
- **show appletalk forward cache**: Displays the forwarding table for the AppleTalk routing protocol.
- **show appletalk routing table**: Displays the global configuration parameters for the AppleTalk routing protocol.
- **show appletalk zone table**: Displays the network numbers and zones learned on the network.
- **show appletalk interface**: Displays the AppleTalk configuration for an individual interface or all interfaces.
- **show appletalk interface zone**: Displays the zones defined on all AppleTalk interfaces.
- **show appletalk route**: Displays the AppleTalk routing table.
- **show appletalk traffic**: Displays statistical information for RTMP, ZIP, AEP, DDP and AARP packets.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Monitor in the tree view to display the monitoring options.
3. Click on the plus sign next to AppleTalk in the tree view to expand the list of AppleTalk option links.
4. Select one of the following links:
    - The ARP Cache link
    - The Forward Cache link
    - The Interface link
    - The Interface Zone link
    - The Routing Table link
    - The Traffic link
    - The Zone Table link

Clearing AppleTalk Information

USING THE CLI

When using the CLI, you can clear AppleTalk data by entering the following CLI commands:

- **clear appletalk arp cache**: Erases all data in the AppleTalk ARP table, as displayed by the **show appletalk arp** command.
- **clear appletalk forward cache**: Erases all learned data from non-local networks that is currently resident in the AppleTalk cache (forwarding table), as displayed by the **show appletalk cache** command.
- **clear appletalk route**: Erases all learned routes and zones (non-local routes and zones) currently resident in the AppleTalk routing table, as displayed by the show appletalk route command.
- **clear appletalk statistics**: Erases all RTMP, ZIP, AEP, DDP, and AARP statistics for the routing switch. You can display a summary of the statistics that will be erased by entering the **show appletalk traffic** command.

NOTE: For more details on these commands, see the *Command Line Interface Reference*.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Command in the tree view to expand the list of command options.
3. Click on the Clear link to display the Clear panel.
4. Select one of the following:
   - AppleTalk ARP Cache
   - AppleTalk Forward Cache
   - AppleTalk Route
   - AppleTalk Statistics
5. Click the Apply button to implement the change.

Chapter 16
Configuring VLANs

This chapter describes how to configure Virtual LANs (VLANs) on the HP 9304M, HP 9308M, and HP 6308M-SX routing switches and the HP 6208M-SX switch.

The “Overview” section provides basic information about the VLAN options. Following this section, other sections provide configuration procedures and examples.

To display configuration information for VLANs, see “Displaying VLAN Information” on page 16-57.

For complete syntax information for the CLI commands shown in this chapter, see the *Command Line Interface Reference*.

Most of the configuration examples in this chapter are based on CLI commands. For Web management procedures, see “Configuring VLANs Using the Web Management Interface” on page 16-50.

Overview

This section describes the VLAN features. Configuration procedures and examples appear in later sections of this chapter.

Types of VLANs

You can configure the following types of VLANs.

- Layer 2 port-based VLAN – a set of physical ports that share a common, exclusive Layer 2 broadcast domain
- Layer 3 protocol VLANs – a subset of ports within a port-based VLAN that share a common, exclusive broadcast domain for Layer 3 broadcasts of the specified protocol type
- IP sub-net VLANs – a subset of ports in a port-based VLAN that share a common, exclusive sub-net broadcast domain for a specified IP sub-net
- IPX network VLANs – a subset of ports in a port-based VLAN that share a common, exclusive network broadcast domain for a specified IPX network
- AppleTalk cable VLANs – a subset of ports in a port-based VLAN that share a common, exclusive network broadcast domain for a specified AppleTalk cable range

When a device receives a packet on a port that is a member of a VLAN, the device forwards the packet based on the following VLAN hierarchy:

- If the port belongs to an IP sub-net VLAN, IPX network VLAN, or AppleTalk cable VLAN, and the packet belongs to the corresponding IP sub-net, IPX network, or AppleTalk cable range, the device forwards the packet to all the ports within that VLAN.
- If the packet is a Layer 3 packet but cannot be forwarded as described above, but the port is a member of a Layer 3 protocol VLAN for the packet's protocol, the device forwards the packet on all the Layer 3 protocol VLAN's ports.
- If the packet cannot be forwarded based on either of the VLAN membership types listed above, but the packet can be forwarded at Layer 2, the device forwards the packet on all the ports within the receiving port's port-based VLAN.

Protocol VLANs differ from IP sub-net, IPX network, and AppleTalk VLANs in an important way. Protocol VLANs accept any broadcast of the specified protocol type. An IP sub-net, IPx network, or AppleTalk VLAN accepts only broadcasts for the specified IP sub-net, IPX network, or AppleTalk cable range.

NOTE: Protocol VLANs are different from IP sub-net, IPX network, and AppleTalk cable VLANs. A port-based VLAN cannot contain both an IP sub-net, IPX network, or AppleTalk cable VLAN and a protocol VLAN for the same protocol. For example, a port-based VLAN cannot contain both an IP protocol VLAN and an IP sub-net VLAN.

Layer 2 Port-Based VLANs

A port-based VLAN is a subset of ports on a device that constitutes a Layer 2 broadcast domain.

By default, all the ports on a device are members of the default VLAN. Thus, all the ports on the device constitute a single Layer 2 broadcast domain. You can configure multiple port-based VLANs. When you configure a port-based VLAN, the device automatically removes the ports you add to the VLAN from the default VLAN.

Figure 16.1 shows an example of a device on which a Layer 2 port-based VLAN has been configured.

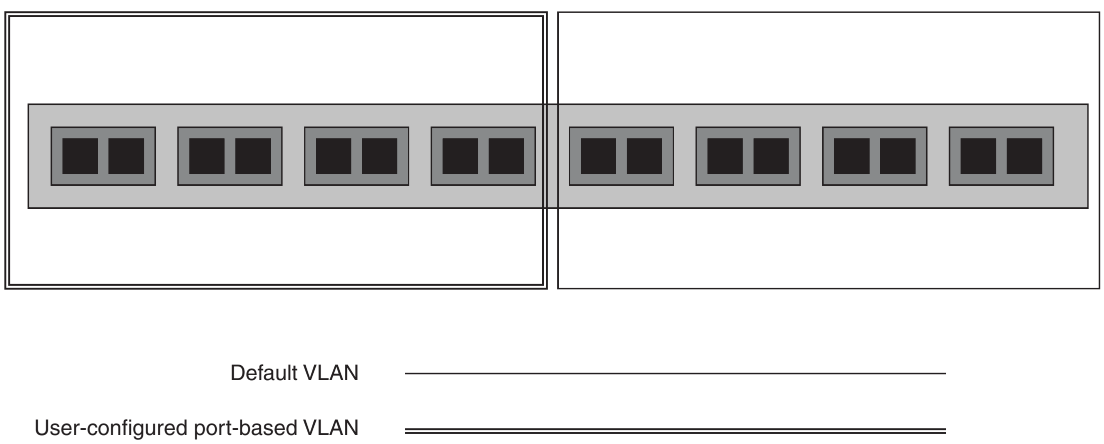


Figure 16.1 Example of a device containing user-defined Layer 2 port-based VLAN

A port can belong to only one port-based VLAN, unless you apply 802.1p tagging to the port. ***802.1p tagging*** allows the port to add a four-byte tag field, which contains the VLAN ID, to each packet sent on the port. You also can configure port-based VLANs that span multiple devices by tagging the ports within the VLAN. The tag enables each device that receives the packet to determine the VLAN the packet belongs to. 802.1p tagging applies only to Layer 2 VLANs, not to Layer 3 VLANs.

Since each port-based VLAN is a separate Layer 2 broadcast domain, by default each VLAN runs a separate instance of the Spanning Tree Protocol (STP).

Layer 2 traffic is bridged within a port-based VLAN and Layer 2 broadcasts are sent to all the ports within the VLAN.

Layer 3 Protocol-Based VLANs

If you want some or all of the ports within a port-based VLAN to be organized according to Layer 3 protocol, you must configure a Layer 3 protocol-based VLAN within the port-based VLAN.

You can configure each of the following types of protocol-based VLAN within a port-based VLAN. All the ports in the Layer 3 VLAN must be in the same Layer 2 VLAN.

- AppleTalk – The device sends AppleTalk broadcasts to all ports within the AppleTalk protocol VLAN.
- IP – The device sends IP broadcasts to all ports within the IP protocol VLAN.
- IPX – The device sends IPX broadcasts to all ports within the IPX protocol VLAN.
- DECnet – The device sends DECnet broadcasts to all ports within the DECnet protocol VLAN.
- NetBIOS – The device sends NetBIOS broadcasts to all ports within the NetBIOS protocol VLAN.
- Other – The device sends broadcasts for all protocol types other than those listed above to all ports within the VLAN.

Figure 16.2 shows an example of Layer 3 protocol VLANs configured within a Layer 2 port-based VLAN.

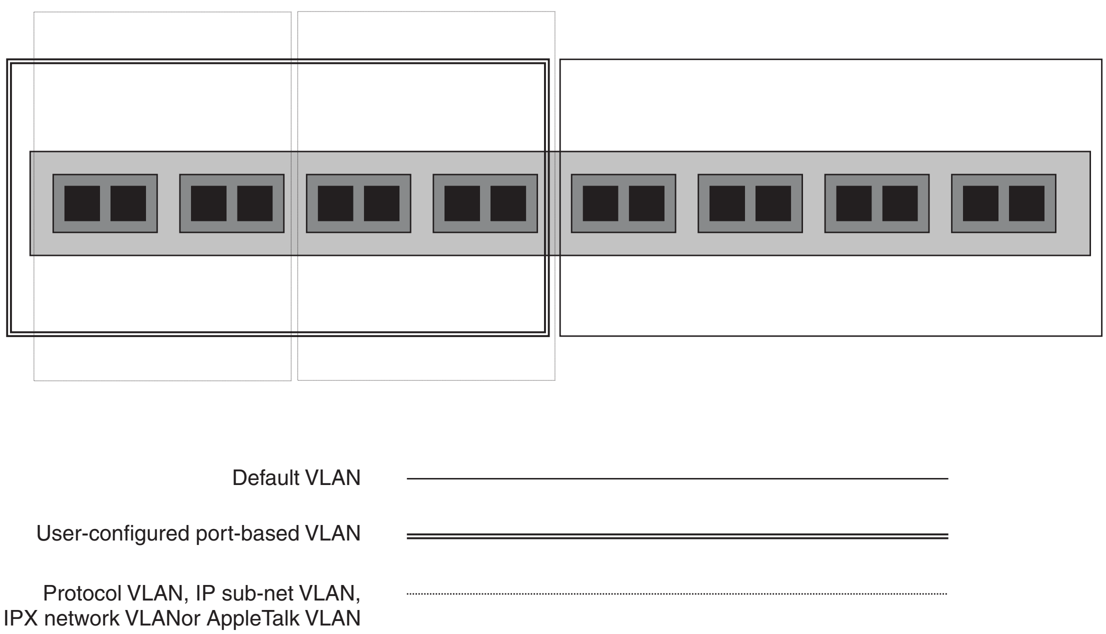


Figure 16.2 Layer 3 protocol VLANs within a Layer 2 port-based VLAN

Integrated Switch Routing (ISR)

The ***Integrated Switch Routing (ISR)*** feature enables VLANs configured on routing switches to route Layer 3 traffic from one protocol VLAN or IP sub-net, IPX network, or AppleTalk cable VLAN to another. Normally, to route traffic from one IP sub-net, IPX network, or AppleTalk cable VLAN to another, you would need to forward the traffic to an external router. The VLANs provide Layer 3 broadcast domains for these protocols but do not in themselves provide routing services for these protocols. This is true even of the source and destination IP sub-nets, IPX networks, or AppleTalk cable ranges are on the same device.

ISR eliminates the need for the external router by allowing you to route between the VLANs, on the same device, using virtual interfaces (VEs).[1] A ***virtual interface*** is a logical port on which you can configure Layer 3 routing parameters. You configure a separate virtual interface on each VLAN that you want to be able to route from or to.

For example, if you configure two IP sub-net VLANs on a routing switch, you can configure a virtual interface on each VLAN, then configure IP routing parameters for the sub-nets. Thus, the routing switch forwards IP sub-net broadcasts within each VLAN at Layer 2 but routes Layer 3 traffic between the VLANs using the virtual interfaces.

NOTE: The routing switch uses the lowest MAC address on the device (the MAC address of port 1 or 1/1) as the MAC address for all ports within all virtual interfaces you configure on the device.

The routing parameters and the syntax for configuring them are the same as when you configure a physical interface for routing. The logical interface allows the routing switch to internally route traffic between the protocol-based VLANs without using physical interfaces.

All the ports within a protocol-based VLAN must be in the same port-based VLAN. The protocol-based VLAN cannot have ports in multiple port-based VLANs, unless the ports in the port-based VLAN to which you add the protocol-based VLAN are 802.1p tagged.

You can configure multiple protocol-based VLANs within the same port-based VLAN. In addition, a port within a port-based VLAN can belong to multiple protocol-based VLANs of the same type or different types. For example, if you have a port-based VLAN that contains ports 1 – 10, you can configure port 5 as a member of an AppleTalk protocol VLAN, an IP protocol VLAN, and an IPX protocol VLAN, and so on.

IP Sub-Net, IPX Network, and AppleTalk Cable VLANs

The protocol-based VLANs described in the previous section provide separate protocol broadcast domains for specific protocols. For IP, IPX, and AppleTalk, you can provide more granular broadcast control by instead creating the following types of VLAN:

- ***IP sub-net VLAN*** – An IP sub-net broadcast domain for a specific IP sub-net.
- ***IPX network VLAN*** – An IPX network broadcast domain for a specific IPX network.
- ***AppleTalk cable VLAN*** – An AppleTalk broadcast domain for a specific cable range.

You can configure these types of VLANs on routing switches only. The routing switch sends broadcasts for the IP sub-net, IPX network, or AppleTalk cable range to all ports within the IP sub-net, IPX network, or AppleTalk cable VLAN at Layer 2.

The routing switch routes packets between VLANs at Layer 3. To configure an IP sub-net, IPX network, or AppleTalk cable VLAN to route, you must add a virtual interface to the VLAN, then configure the appropriate routing parameters on the virtual interface.

NOTE: The routing switch routes packets between VLANs of the same protocol. The routing switch cannot route from one protocol to another.

NOTE: IP sub-net VLANs are not the same thing as IP protocol VLANs. An IP protocol VLAN sends all IP broadcasts on the ports within the IP protocol VLAN. An IP sub-net VLAN sends only the IP sub-net broadcasts for the sub-net of the VLAN. You cannot configure an IP protocol VLAN and an IP sub-net VLAN within the same port-based VLAN.

This note also applies to IPX protocol VLANs and IPX network VLANs, and to AppleTalk protocol VLANs and AppleTalk cable VLANs.

1.The acronym “VE” stands for “Virtual Ethernet”.

Default VLAN

By default, all the ports on a device are in a single port-based VLAN. This VLAN is called DEFAULT-VLAN and is VLAN number 1. The routing switches and the switch do not contain any protocol VLANs or IP sub-net, IPX network, or AppleTalk cable VLANs by default.

Figure 16.3 shows an example of the default Layer 2 port-based VLAN.

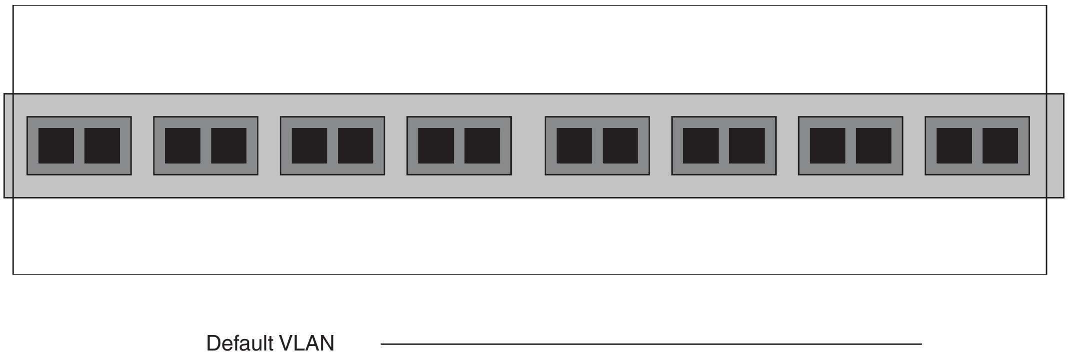


Figure 16.3 Default Layer 2 port-based VLAN

When you configure a port-based VLAN, one of the configuration items you provide is the ports that are in the VLAN. When you configure the VLAN, the device automatically removes the ports that you place in the VLAN from DEFAULT-VLAN. By removing the ports from the default VLAN, the device ensures that each port resides in only one Layer 2 broadcast domain.

NOTE: Information for the default VLAN is available only after you define another VLAN.

Some network configurations may require that a port be able to reside in two or more Layer 2 broadcast domains (port-based VLANs). In this case, you can enable a port to reside in multiple port-based VLANs by tagging the port. See the following section.

If your network requires that you use VLAN ID 1 for a user-configured VLAN, you can reassign the default VLAN to another valid VLAN ID. See “Assigning a Different VLAN ID to the Default VLAN” on page 16-13.

802.1p Tagging

802.1p tagging is an IEEE standard that allows a networking device to add information to a Layer 2 packet in order to identify the VLAN membership of the packet. The routing switches and the switch tag a packet by adding a four-byte tag to the packet. The tag contains the tag value, which identifies the data as a tag, and also contains the VLAN ID of the VLAN from which the packet is sent.

- The default tag value is 8100 (hexadecimal). This value comes from the 802.1p specification. You can change this tag value on a global basis if needed to be compatible with other vendors’ equipment.
- The VLAN ID is determined by the VLAN on which the packet is being forwarded.

Figure 16.4 shows the format of packets with and without the 802.1p tag. The tag format is vendor-specific. To use the tag for VLANs configured across multiple devices, make sure all the devices support the same tag format.

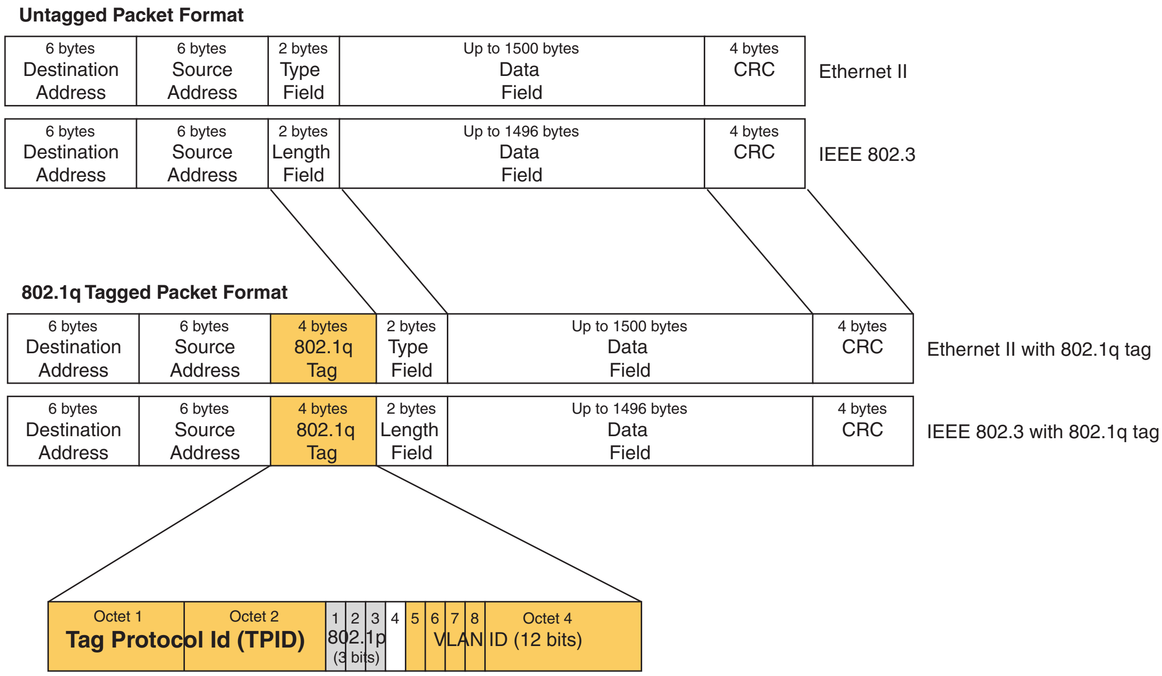


Figure 16.4 Packet containing the 802.1Q VLAN tag

NOTE: You cannot configure a port to be a member of the default port-based VLAN and another port-based VLAN at the same time. Once you add a port to a port-based VLAN, the port is no longer a member of the default VLAN. The port returns to the default VLAN only if you delete the other VLAN(s) that contains the port.

If you configure a VLAN that spans multiple devices, you need to use tagging only if a port connecting one of the devices to the other is a member of more than one port-based VLAN. If a port connecting one device to the other is member of only a single port-based VLAN, tagging is not required.

If you use tagging on multiple devices, each device must be configured for tagging and must use the same tag value. In addition, the implementation of tagging must be compatible on the devices.

Figure 16.5 shows an example of two devices that have the same Layer 2 port-based VLANs configured across them. Notice that only one of the VLANs requires tagging.

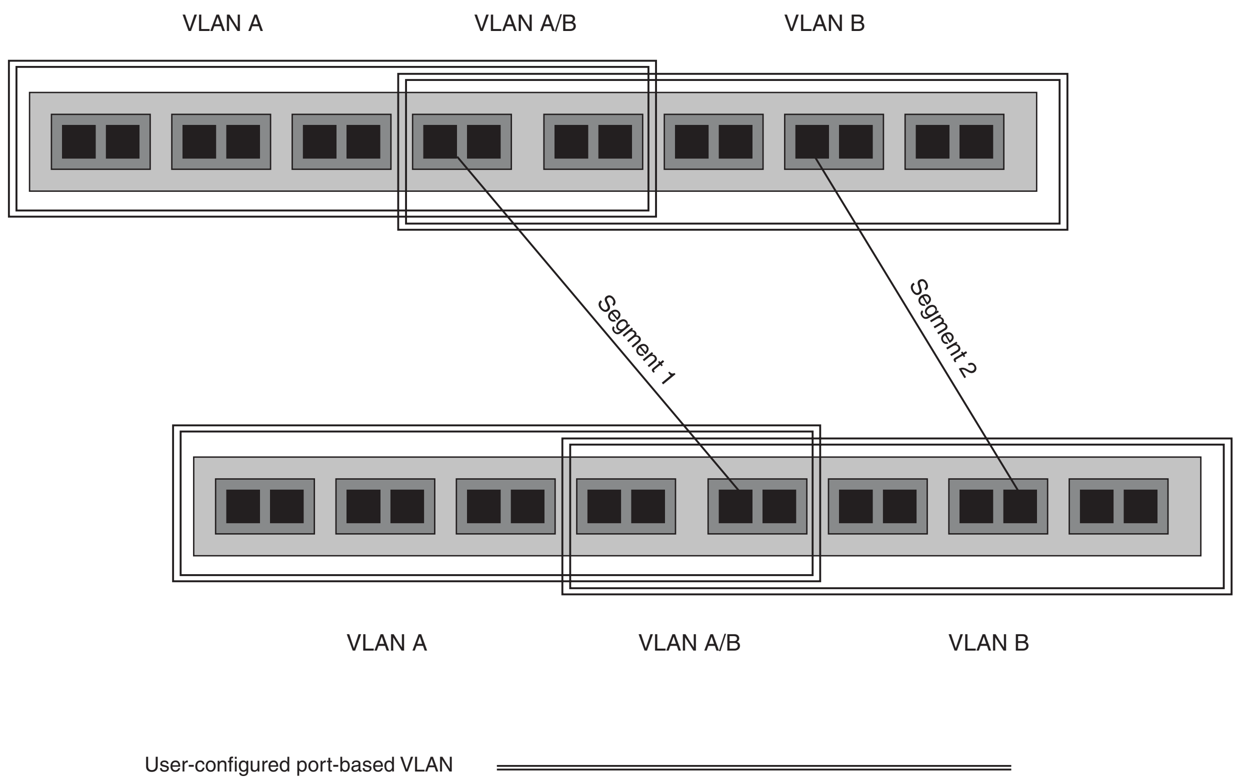


Figure 16.5 VLANs configured across multiple devices

Spanning Tree Protocol (STP)

The default state of STP depends on the device type:

- STP is disabled by default on the HP 9304M, HP 9308M, and HP 6308M-SX routing switches.
- STP is enabled by default on the HP 6208M-SX switch.

Also by default, each port-based VLAN has a separate instance of STP. Thus, when STP is globally enabled, each port-based VLAN on the device runs a separate spanning tree.

You can enable or disable STP on the following levels:

- Globally – Affects all ports on the device.

> **NOTE:** When you configure a VLAN, the VLAN inherits the global STP settings. However, once you begin to define a VLAN, you can no longer configure STP globally. From that point on, you can configure STP only within individual VLANs.

- Port-based VLAN – Affects all ports within the specified port-based VLAN. When you enable or disable STP within a port-based VLAN, the setting overrides the global setting. Thus, you can enable STP for the ports within a port-based VLAN even when STP is globally disabled, or disable the ports within a port-based VLAN when STP is globally enabled.

STP is a Layer 2 protocol. Thus, you cannot enable or disable STP for individual protocol VLANs or for IP sub-net, IPX network, or AppleTalk cable VLANs. The STP state of a port-based VLAN containing these other types of VLANs determines the STP state for all the Layer 2 broadcasts within the port-based VLAN. This is true even though Layer 3 protocol broadcasts are sent on Layer 2 within the VLAN.

It is possible that STP will block one or more ports in a protocol VLAN that uses a virtual interface to route to other VLANs. For IP protocol and IP sub-net VLANs, even though some of the physical ports of the virtual interface are

blocked, the virtual interface can still route so long as at least one port in the virtual interface's protocol VLAN is not blocked by STP.

NOTE: If you plan to connect the device to networking devices that run only a single instance of STP on all ports, you can configure the device to run a single instance of STP on all ports. However, doing so causes the device to stop using the individual VLANs you have configured and instead places all ports in a single logical VLAN, which is VLAN 4094. See the addendum or release notes shipped with your product for information.

Virtual Interfaces

A virtual interface is a logical routing interface that routing switches use to route Layer 3 protocol traffic between protocol VLANs.

The routing switches send Layer 3 traffic at Layer 2 within a protocol VLAN. However, Layer 3 traffic from one protocol VLAN to another must be routed.

If you want the device to be able to send Layer 3 traffic from one protocol VLAN to another, you must configure a virtual interface on each protocol VLAN, then configure routing parameters on the virtual interfaces. For example, to enable a routing switch to route IP traffic from one IP sub-net VLAN to another, you must configure a virtual interface on each IP sub-net VLAN, then configure the appropriate IP routing parameters on each of the virtual interfaces.

Figure 16.6 shows an example of Layer 3 protocol VLANs that use virtual interfaces for routing.

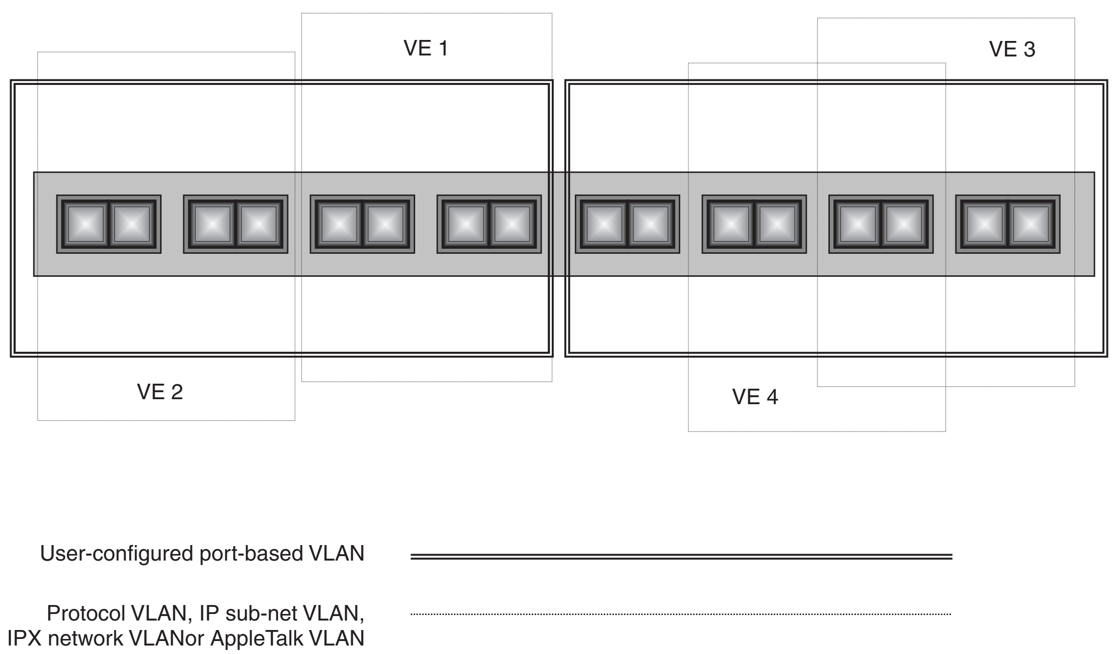


Figure 16.6 Use virtual interfaces for routing between Layer 3 protocol VLANs

VLAN and Virtual Interface Groups

To simplify configuration, you can configure VLAN groups and virtual interface groups. When you create a VLAN group, the VLAN parameters you configure for the group apply to all the VLANs within the group. Additionally, you can easily associate the same IP sub-net interface with all the VLANs in a group by configuring a virtual interface group with the same ID as the VLAN group.

For configuration information, see "Configuring VLAN Groups and Virtual Interface Groups" on page 16-39.

Dynamic, Static, and Excluded Port Membership

When you add ports to a protocol VLAN, IP sub-net VLAN, IPX network VLAN, or AppleTalk cable VLAN, you can add them dynamically or statically:

- Dynamic ports
- Static ports

You also can explicitly exclude ports.

Dynamic Ports

Dynamic ports are added to a VLAN when you create the VLAN. However, if a dynamically added port does not receive any traffic for the VLAN's protocol within ten minutes, the port is removed from the VLAN. However, the port remains a candidate for port membership. Thus, if the port receives traffic for the VLAN's protocol, the device adds the port back to the VLAN.

After the port is added back to the VLAN, the port can remain an active member of the VLAN up to 20 minutes without receiving traffic for the VLAN's protocol. If the port ages out, it remains a candidate for VLAN membership and is added back to the VLAN when the VLAN receives protocol traffic. At this point, the port can remain in the VLAN up to 20 minutes without receiving traffic for the VLAN's protocol, and so on.

Unless you explicitly add a port statically or exclude a port, the port is a dynamic port and thus can be an active member of the VLAN, depending on the traffic it receives.

NOTE: You cannot configure dynamic ports in an AppleTalk cable VLAN. The ports in an AppleTalk cable VLAN must be static. However, ports in an AppleTalk protocol VLAN can be dynamic or static.

Figure 16.7 shows an example of a VLAN with dynamic ports. Dynamic ports not only join and leave the VLAN according to traffic, but also allow some broadcast packets of other protocol types to "leak" through the VLAN. See "Broadcast Leaks" on page 16-10.

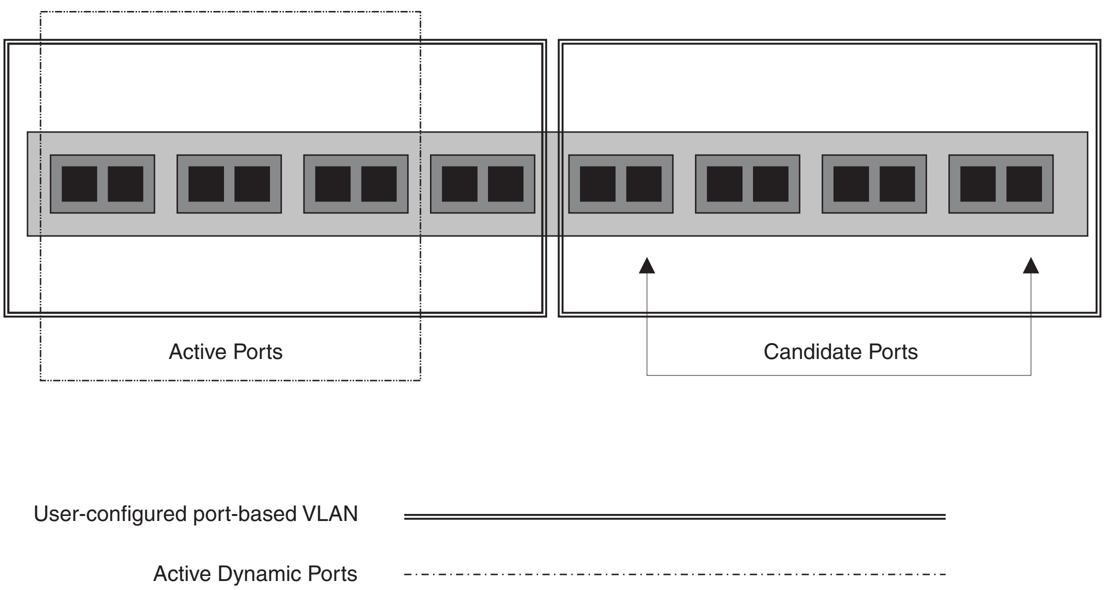


Figure 16.7 VLAN with dynamic protocol ports—all ports are active when you create the VLAN

Ports in a new protocol VLAN that do not receive traffic for the VLAN's protocol age out after 10 minutes and become candidate ports.

Static Ports

Static ports are permanent members of the protocol VLAN. The ports remain active members of the VLAN regardless of whether the ports receive traffic for the VLAN's protocol. You must explicitly identify the port as a static port when you add it to the VLAN. Otherwise, the port is dynamic and is subject to aging out.

In addition, static ports never "leak" broadcast packets of other protocol types. (See "Broadcast Leaks" on page 16-10.)

Excluded Ports

If you want to prevent a port in a port-based VLAN from ever becoming a member of a protocol, IP sub-net, IPX network, or AppleTalk cable VLAN configured in the port-based VLAN, you can explicitly exclude the port. You exclude the port when you configure the protocol, IP sub-net, IPX network, or AppleTalk cable VLAN.

Broadcast Leaks

Dynamic ports differ from static ports in an important way. Static ports never allow broadcasts for protocols other than the protocol of the VLAN to be forwarded on the port. Thus, an IP protocol VLAN forwards only IP broadcast packets and never broadcasts any Layer 3 broadcasts of other protocol types. If you want to ensure that no broadcasts other than those of the VLAN's protocol get through, use static ports.

Dynamic ports "leak" every eighth broadcast packet of another protocol type through the port. Thus, if an IP protocol VLAN receives eight AppleTalk broadcast packets, the VLAN port drops the first seven packets but sends the eighth packet. This behavior enables a PC, Macintosh computer, or workstation that joins the network to find its servers, even if the LAN segment the device is on is configured as part of a protocol VLAN for a different protocol. For example, if a few of your network users have Macintosh computers, they can still find their printers or other servers even if the network segment they are on is part of an IP protocol VLAN.

The VLAN ports maintain separate counters for each protocol. Thus, if a port in an IP protocol VLAN receives four AppleTalk broadcast packets and four DECnet broadcast packets, the port still does not forward any of the packets. Only when the port receives eight AppleTalk broadcast packets or eight DECnet broadcast packets does the port send the eighth packet of that protocol type.

Figure 16.8 shows an example of a Layer 3 IP protocol VLAN with dynamic ports. Since the ports have dynamic membership, they are "leaky". They forward every eighth broadcast packet of non-IP protocols. For example, when the Macintosh computer sends its eighth broadcast packet, the VLAN forwards the packet. In a VLAN with static ports, the VLAN never forwards broadcast packets of other protocol types.

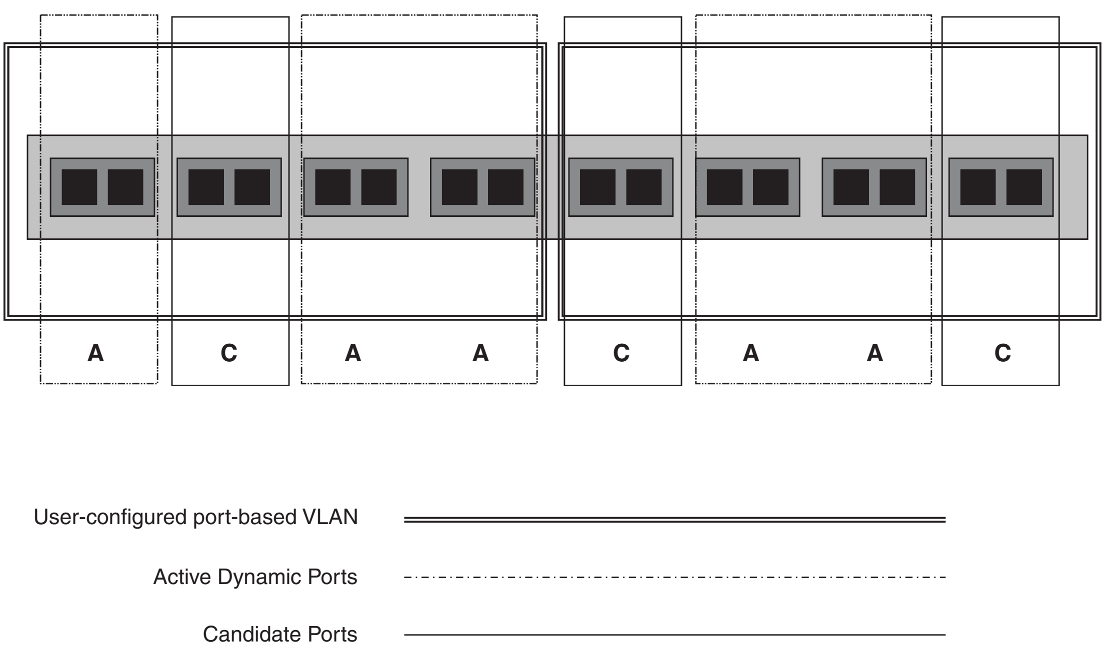


Figure 16.8 Protocol VLAN with "leaky" (dynamic) ports

Super Aggregated VLANs

You can aggregate multiple VLANs within another VLAN. This feature allows you to construct Layer 2 paths and channels. This feature is particularly useful for Virtual Private Network (VPN) applications ins which you need to provide a private, dedicated Ethernet connection for an individual client to transparently reach its sub-net across multiple networks.

For an application example and configuration information, see “Configuring Super Aggregated VLANs” on page 16-43.

Trunk Group Ports and VLAN Membership

A trunk group is a set of physical ports that are configured to act as a single physical interface. Each trunk group’s port configuration is based on the configuration of the lead port, which is the lowest numbered port in the group.

If you add a trunk group’s lead port to a VLAN, all of the ports in the trunk group become members of that VLAN.

Summary of VLAN Configuration Rules

A hierarchy of VLANs exists between the Layer 2 and Layer 3 protocol-based VLANs:

- Port-based VLANs are at the lowest level of the hierarchy.
- Layer 3 protocol-based VLANs, IP, IPX, AppleTalk, Decnet, and NetBIOS are at the middle level of the hierarchy.
- IP sub-net, IPX network, and AppleTalk cable VLANs are at the top of the hierarchy.

NOTE: You cannot have a protocol-based VLAN and a sub-net or network VLAN of the same protocol type in the same port-based VLAN. For example, you can have an IPX protocol VLAN and IP sub-net VLAN in the same port-based VLAN, but you cannot have an IP protocol VLAN and an IP sub-net VLAN in the same port-based VLAN, nor can you have an IPX protocol VLAN and an IPX network VLAN in the same port-based VLAN.

As a device receives packets, the VLAN classification starts from the highest level VLAN first. Therefore, if an interface is configured as a member of both a port-based VLAN and an IP protocol VLAN, IP packets coming into the interface are classified as members of the IP protocol VLAN because that VLAN is higher in the VLAN hierarchy.

Multiple VLAN Membership Rules

- A port can belong to multiple, unique, overlapping Layer 3 protocol-based VLANs without VLAN tagging.
- A port can belong to multiple, overlapping Layer 2 port-based VLANs only if the port is a tagged port. Packets sent out of a tagged port use an 802.1p-tagged frame.
- When both port and protocol-based VLANs are configured on a given device, all protocol VLANs must be strictly contained within a port-based VLAN. A protocol VLAN cannot include ports from multiple port-based VLANs. This rule is required to ensure that port-based VLANs remain loop-free Layer 2 broadcast domains.
- IP-Protocol and IP-Subnet VLANs cannot operate concurrently on the system or within the same port-based VLAN.
- IPX-Protocol and IPX-Network VLANs cannot operate concurrently on the system or within the same port-based VLAN.
- If you first configure IP and IPX protocol VLANs before deciding to partition the network by IP sub-net and IPX network VLANs, then you need to delete those VLANs before creating the IP sub-net and IPX network VLANs.
- One of each type of protocol VLAN is configurable within each port-based VLAN on the switch.
- Multiple IP-Subnet and IPX-Network VLANs are configurable within each port-based VLAN on the switch.
- Removing a configured port-based VLAN from a routing switch or switch automatically removes any protocol-based VLAN, IP-Subnet VLAN, AppleTalk cable VLAN, or IPX-Network VLAN, or any virtual interfaces defined within the Port-based VLAN.

Routing Between VLANs (Routing Switches Only)

The routing switches can locally route IP, IPX, and Appletalk between VLANs defined within a single routing switch. All other routable protocols or protocol VLANs (for example, DecNet) must be routed by another external router capable of routing the protocol.

Virtual Interfaces (Routing Switches Only)

Virtual interfaces must be defined at the highest level of the VLAN hierarchy. You need to configure virtual interfaces if an IP, IPX, or Appletalk protocol VLAN, IP sub-net VLAN, AppleTalk cable VLAN, or IPX network VLAN is defined within a port-based VLAN on a routing switch. You also you need to route these protocols to another port-based VLAN on the same routing switch. You need to configure a separate virtual interface within each of the protocol, subnet or network VLANs that are defined to the port-based VLAN. This configuration would require three virtual interfaces for a single port-based VLAN.

If you do not need to further partition the port-based VLAN by defining separate Layer 3 VLANs, you can define a single virtual interface at the port-based VLAN level and enable IP, IPX, and Appletalk routing on a single virtual interface.

Bridging and Routing the Same Protocol Simultaneously on the Same Device (Routing Switches Only)

Some configurations may require simultaneous switching and routing of the same single protocol across different sets of ports on the same routing switch. When IP, IPX, or Appletalk routing is enabled on a routing switch, you can route these protocols on specific interfaces while bridging them on other interfaces. In this scenario, you can create two separate backbones for the same protocol, one bridged and one routed.

To bridge IP, IPX, or Appletalk at the same time these protocols are being routed, you need to configure an IP protocol, IP sub-net, IPX protocol, IPX network, or Appletalk protocol VLAN and not assign a virtual interface to the VLAN. Packets for these protocols are bridged or switched at Layer 2 across ports on the routing switch that are included in the Layer 3 VLAN. If these VLANs are built within port-based VLANs, they can be tagged across a single set of backbone fibers to create separate Layer 2 switched and Layer 3 routed backbones for the same protocol on a single physical backbone.

Routing Between VLANs Using Virtual Interfaces (Routing Switches Only)

The ***Integrated Switch Routing (ISR)*** feature allows routing switches to route between VLANs. There are some important concepts to understand before designing an ISR backbone.

Virtual interfaces can be defined on port-based, IP protocol, IP sub-net, IPX protocol, IPX network, AppleTalk protocol, and AppleTalk cable VLANs.

To create any type of VLAN on a routing switch, Layer 2 forwarding must be enabled. When Layer 2 forwarding is enabled, the routing switch becomes a Layer 2 switch on all ports for all non-routable protocols.

If the router interfaces for IP, IPX, or AppleTalk are configured on physical ports, then routing occurs independent of the Spanning Tree Protocol (STP). However, if the router interfaces are defined for any type VLAN, they are virtual interfaces and are subject to the rules of STP.

If your backbone is comprised of virtual interfaces all within the same STP domain, it is a bridged backbone, not a routed one. This means that the set of backbone interfaces that are blocked by STP will be blocked for routed protocols as well. The routed protocols will be able to cross these paths only when the STP state of the link is FORWARDING. This problem is easily avoided by proper network design.

When designing an ISR network, pay attention to your use of virtual interfaces and the spanning-tree domain. If Layer 2 switching of your routed protocols (IP, IPX, AppleTalk) is not required across the backbone, then the use of virtual interfaces can be limited to edge switch ports within each routing switch. Full backbone routing can be achieved by configuring routing on each physical interface that connects to the backbone. Routing is independent of STP when configured on a physical interface.

If your ISR design requires that you switch IP, IPX, or Appletalk at Layer 2 while simultaneously routing the same protocols over a single backbone, then create multiple port-based VLANs and use VLAN tagging on the backbone links to separate your Layer 2 switched and Layer 3 routed networks.

There is a separate STP domain for each port-based VLAN. Routing occurs independently across port-based VLANs or STP domains. You can define each end of each backbone link as a separate tagged port-based VLAN. Routing will occur independently across the port-based VLANs. Because each port-based VLAN's STP domain is a single point-to-point backbone connection, you are guaranteed to never have an STP loop. STP will never block the virtual interfaces within the tagged port-based VLAN, and you will have a fully routed backbone.

Assigning a Different VLAN ID to the Default VLAN

When you enable port-based VLANs, all ports in the system are added to the default VLAN. By default, the default VLAN ID is "VLAN 1". The default VLAN is not configurable. If you want to use the VLAN ID "VLAN 1" as a configurable VLAN, you can assign a different VLAN ID to the default VLAN.

To reassign the default VLAN to a different VLAN ID, enter the following command:

```
HP9300(config)# default-vlan-id 4095
```

Syntax: default-vlan-d <vlan-id>

You must specify a valid VLAN ID that is not already in use. For example, if you have already defined VLAN 10, do not try to use "10" as the new VLAN ID for the default VLAN. Valid VLAN IDs are numbers from 1 – 4095.

NOTE: Changing the default VLAN name does not change the properties of the default VLAN. Changing the name allows you to use the VLAN ID "1" as a configurable VLAN.

Assigning Trunk Group Ports

When a "lead" trunk group port is assigned to a VLAN, all other members of the trunk group are automatically added to that VLAN. A lead port is the first port of a trunk group port range; for example, "1" in 1 – 4 or "5" in 5 – 8. See "Configuring Trunk Groups" in the "Configuring Basic Features" chapter of Book 1.

Configuring Port-Based VLANs

Port-based VLANs allow you to provide separate spanning tree protocol (STP) domains or broadcast domains on a port-by-port basis.

This section describes how to perform the following tasks for port-based VLANs using the CLI:

- Create a VLAN.
- Delete a VLAN.
- Modify a VLAN.
- Assign a higher priority to the VLAN.
- Change a VLAN's priority.
- Enable or disable STP on the VLAN.

EXAMPLE:

Figure 16.9 shows a simple port-based VLAN configuration using a single HP 6208M-SX switch. All ports within each VLAN are untagged. One untagged port within each VLAN is used to connect the switch to a routing switch (in this example, an HP 6308M-SX) for Layer 3 connectivity between the two port-based VLANs.

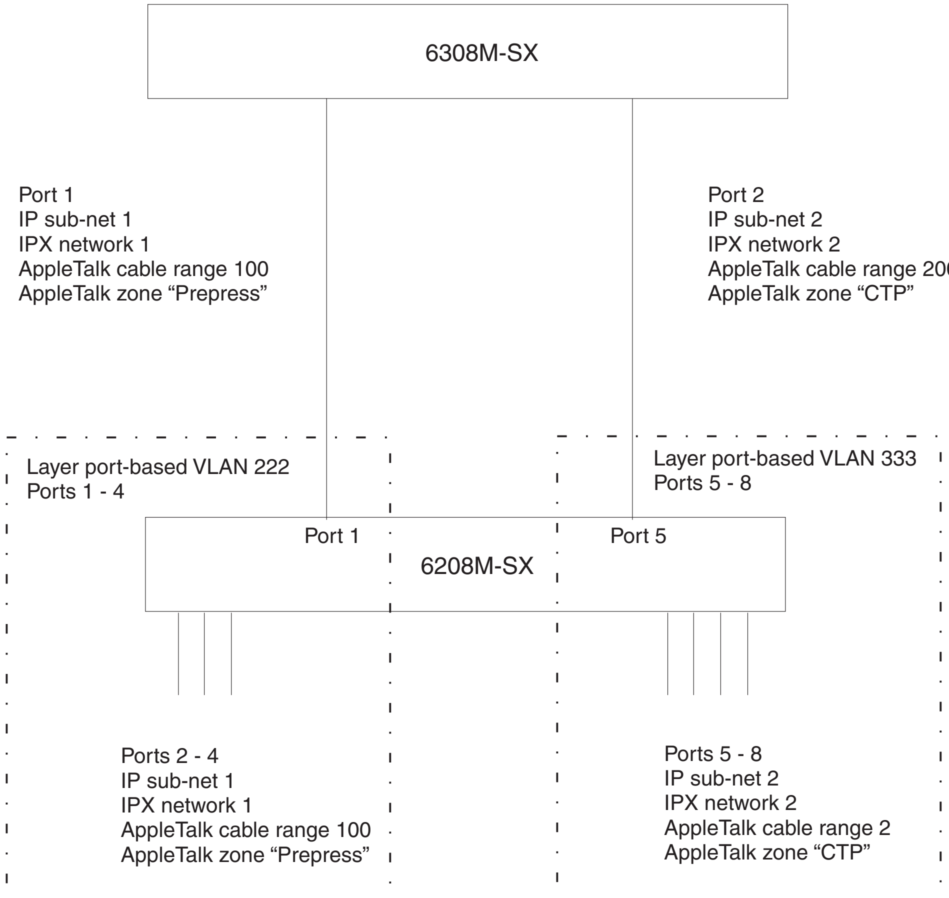


Figure 16.9 Port-based VLANs 222 and 333

To create the two port-based VLANs shown in Figure 16.9, use the following method.

USING THE CLI

```
HP6208(config)# vlan 222 by port

HP6208(config-vlan-222)# untag e1 to 4

HP6208(config-vlan-222)# vlan 333 by port

HP6208(config-vlan-333)# untag e5 to 8

HP6208(config-vlan-333)# write memory
```

Syntax: vlan <vlan-id> by port

Syntax: untagged ethernet <portnum> [to <portnum> | ethernet <portnum>]

EXAMPLE:

Figure 16.10 shows a more complex port-based VLAN configuration using multiple switches and IEEE 802.1p VLAN tagging. The backbone link connecting the three switches is tagged. One untagged port within each port-based VLAN on 6208M-SX A connects each separate network-wide Layer 2 broadcast domain to the routing switch for Layer 3 forwarding between broadcast domains. The STP priority is configured to force 6208M-SX A to be the root bridge for VLAN BROWN. The STP priority on 6208M-SX B is configured so that 6208M-SX B is the root bridge for VLAN GREEN.

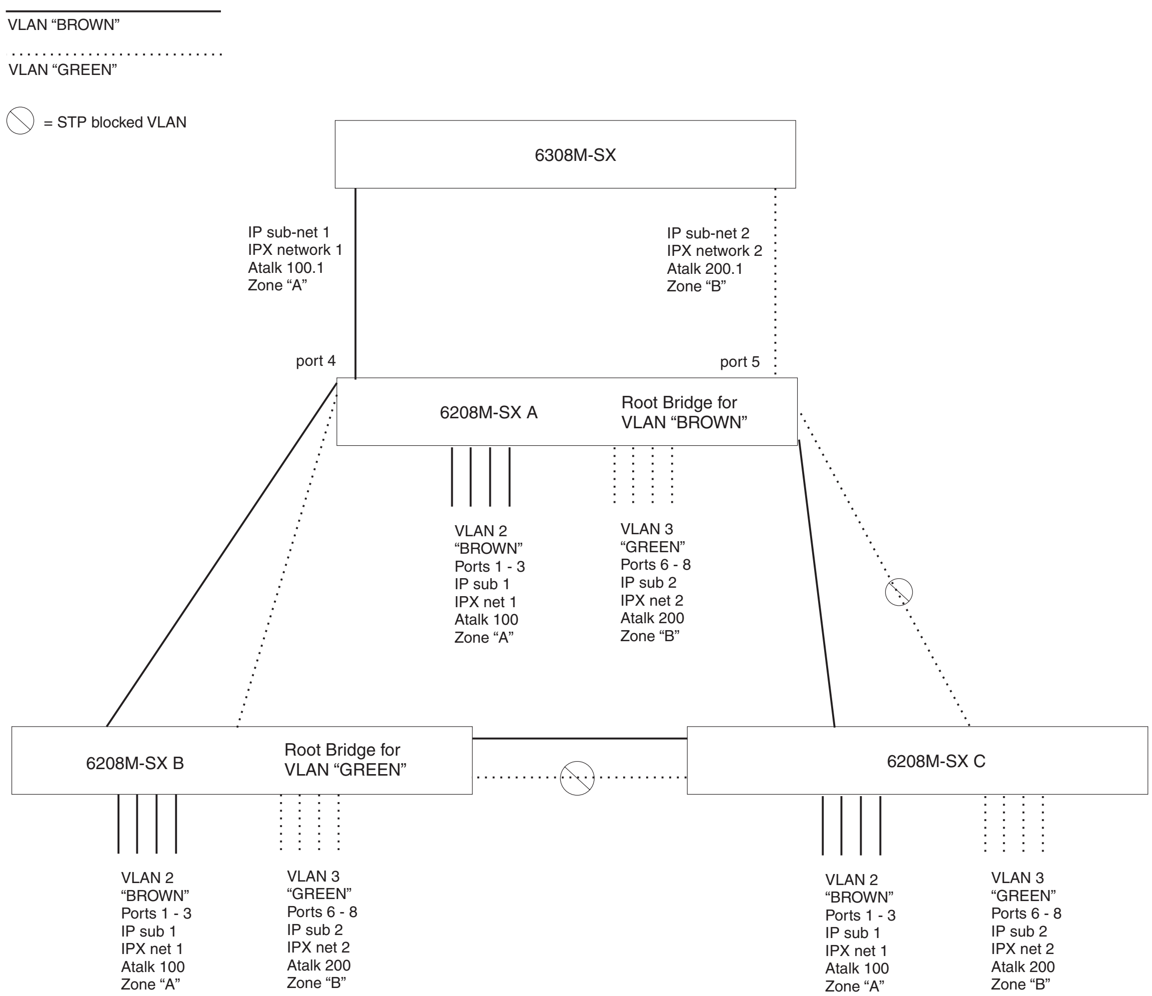


Figure 16.10 More complex port-based VLAN

To configure the Port-based VLANs on the HP 6208M-SX switches in Figure 16.10, use the following method.

USING THE CLI

Configuring 6208M-SX A

Enter the following commands to configure 6208M-SX A:

```
HP6208> enable
HP6208# configure terminal
HP6208(config)# hostname HP6208-A
HP6208-A(config)# vlan 2 name BROWN
HP6208-A(config-vlan-2)# untag ethernet 1 to 4
HP6208-A(config-vlan-2)# tag ethernet 7 to 8
HP6208-A(config-vlan-2)# spanning-tree
HP6208-A(config-vlan-2)# vlan 3 name GREEN
HP6208-A(config-vlan-3)# untag ethernet 4 to 6 ethernet 8
```

```
HP6208-A(config-vlan-3)# tag ethernet 7 to 8
HP6208-A(config-vlan-3)# spanning-tree
HP6208-A(config-vlan-3)# write memory
```

Configuring 6208M-SX B

Enter the following commands to configure 6208M-SX B:

```
HP6208> en
HP6208# configure terminal
HP6208(config)# hostname HP6208-B
HP6208-B(config)# vlan 2 name BROWN
HP6208-B(config-vlan-2)# untag ethernet 1 to 3
HP6208-B(config-vlan-2)# tag ethernet 7 to 8
HP6208-B(config-vlan-2)# spanning-tree
HP6208-B(config-vlan-2)# spanning-tree priority 500
HP6208-B(config-vlan-2)# vlan 3 name GREEN
HP6208-B(config-vlan-3)# untag ethernet 4 to 6
HP6208-B(config-vlan-3)# tag ethernet 7 to 8
HP6208-B(config-vlan-3)# spanning-tree
HP6208-B(config-vlan-3)# spanning-tree priority 500
HP6208-B(config-vlan-3)# write memory
```

Configuring 6208M-SX C

Enter the following commands to configure 6208M-SX C:

```
HP6208> en
HP6208# configure terminal
HP6208(config)# hostname HP6208-C
HP6208-C(config)# vlan 2 name BROWN
HP6208-C(config-vlan-2)# untag ethernet 1 to 3
HP6208-C(config-vlan-2)# tag ethernet 7 to 8
HP6208-C(config-vlan-2)# vlan 3 name GREEN
HP6208-C(config-vlan-3)# untag ethernet 4 to 6
HP6208-C(config-vlan-3)# tag ethernet 7 to 8
HP6208-C(config-vlan-5)# write memory
```

Syntax: vlan <vlan-id> by port

Syntax: untagged ethernet <portnum> [to <portnum> | ethernet <portnum>]

Syntax: tagged ethernet <portnum> [to <portnum> | ethernet <portnum>]

Syntax: [no] spanning-tree

Syntax: spanning-tree [ethernet <portnum> path-cost <value> priority <value>] forward-delay <value> hello-time <value> maximum-age <time> priority <value>

Modifying a Port-Based VLAN

You can make the following modifications to a port-based VLAN:

- Add or delete a VLAN port.
- Change its priority.
- Enable or disable STP.

Removing a Port-Based VLAN

Suppose you want to remove VLAN 5 from the example in Figure 16.10. To do so, use the following procedure.

USING THE CLI

1. Access the global CONFIG level of the CLI on 6208M-SX A by entering the following commands:

```
HP6208-A> enable
No password has been assigned yet...
HP6208-A# configure terminal
HP6208-A(config)#
```

2. Enter the following command:

```
HP6208-A(config)# no vlan 5
HP6208-A(config)#
```

3. Enter the following commands to exit the CONFIG level and save the configuration to the system-config file on flash memory:

```
HP6208-A(config)#
HP6208-A(config)# end
HP6208-A# write memory
HP6208-A#
```

4. Repeat steps 1 – 3 on 6208M-SX B.

Syntax: no vlan <vlan-id> by port

Removing a Port from a VLAN

Suppose you want to remove port 11 from VLAN 4 on 6208M-SX A shown in Figure 16.10. To do so, use the following procedure.

USING THE CLI

1. Access the global CONFIG level of the CLI on 6208M-SX A by entering the following command:

```
HP6208-A> enable
No password has been assigned yet...
HP6208-A# configure terminal
HP6208-A(config)#
```

2. Access the level of the CLI for configuring port-based VLAN 4 by entering the following command:

```
HP6208-A(config)#
HP6208-A(config)# vlan 4
HP6208-A(config-vlan-4)#
```

3. Enter the following commands:

```
HP6208-A(config-vlan-4)#
HP6208-A(config-vlan-4)# no untag ethernet 11
deleted port ethe 11 from port-vlan 4.
HP6208-A(config-vlan-4)#
```

4. Enter the following commands to exit the VLAN CONFIG mode and save the configuration to the system-config file on flash memory:

```
HP6208-A(config-vlan-4)#
HP6208-A(config-vlan-4)# end
HP6208-A# write memory
HP6208-A#
```

Assigning a Higher Priority to a VLAN

Suppose you wanted to give all traffic on Purple VLAN 2 in Figure 16.10 higher priority than all the other VLANs. Use the following procedure to do so.

USING THE CLI

1. Access the global CONFIG level of the CLI on 6208M-SX A by entering the following command:

```
HP6208-A> enable
No password has been assigned yet...
HP6208-A# configure terminal
HP6208-A(config)#
```

2. Access the level of the CLI for configuring port-based VLAN 2 by entering the following command:

```
HP6208-A(config)#
HP6208-A(config)# vlan 2
HP6208-A(config-vlan-2)#
```

3. Enable all packets exiting the switch on VLAN 2 to transmit from the high priority hardware queue of each transmit interface. Possible QoS priority levels are 0 (normal) – 7 (highest).

```
HP6208-A(config-vlan-2)#
HP6208-A(config-vlan-2)# priority high
HP6208-A(config-vlan-2)#
```

4. Enter the following commands to exit the VLAN CONFIG mode and save the configuration to the system-config file on flash memory:

```
HP6208-A(config-vlan-2)#
HP6208-A(config-vlan-2)# end
HP6208-A# write memory
HP6208-A#
```

5. Repeat steps 1 – 4 on 6208M-SX B.

Syntax: vlan <vlan-id> by port

Syntax: priority normal | high

Enable Spanning Tree on a VLAN

The spanning tree bridge and port parameters are configurable using one CLI command set at the Global Configuration Level of each Port-based VLAN. Suppose you wanted to enable the IEEE 802.1d STP across VLAN 3. To do so, use the following method.

NOTE: When port-based VLANs are not operating on the system, STP is set on a system-wide level at the global CONFIG level of the CLI.

USING THE CLI

1. Access the global CONFIG level of the CLI on 6208M-SX A by entering the following commands:

```
HP6208-A> enable
No password has been assigned yet...
HP6208-A# configure terminal
HP6208-A(config)#
```

2. Access the level of the CLI for configuring port-based VLAN 3 by entering the following command:

```
HP6208-A(config)#
HP6208-A(config)# vlan 3
HP6208-A(config-vlan-3)#
```

3. From VLAN 3's configuration level of the CLI, enter the following command to enable STP on all tagged and untagged ports associated with VLAN 3.

```
HP6208-B(config-vlan-3)#
HP6208-B(config-vlan-3)# spanning-tree
HP6208-B(config-vlan-3)#
```

4. Enter the following commands to exit the VLAN CONFIG mode and save the configuration to the system-config file on flash memory:

```
HP6208-B(config-vlan-3)#
HP6208-B(config-vlan-3)# end
HP6208-B# write memory
HP6208-B#
```

5. Repeat steps 1 – 4 on 6208M-SX B.

NOTE: You do not need to configure values for the STP parameters. All parameters have default values as noted below. Additionally, all values will be globally applied to all ports on the system or on the port-based VLAN for which they are defined.

To configure a specific path-cost or priority value for a given port, enter those values using the key words in the brackets [ ] shown in the syntax summary below. If you do not want to specify values for any given port, this portion of the command is not required.

Syntax: vlan <vlan-id> by port

Syntax: [no] spanning-tree

Syntax: spanning-tree [ethernet <portnum> path-cost <value> priority <value>] forward-delay <value> hello-time <value> maximum-age <time> priority <value>

Bridge STP Parameters (applied to all ports within a VLAN)

- Forward Delay – the period of time a bridge will wait (the listen and learn period) before forwarding data packets. Possible values: 4 – 30 seconds. Default is 15.
- Maximum Age – the interval a bridge will wait for receipt of a hello packet before initiating a topology change. Possible values: 6 – 40 seconds. Default is 20.
- Hello Time – the interval of time between each configuration BPDU sent by the root bridge. Possible values: 1 – 10 seconds. Default is 2.

- Priority – a parameter used to identify the root bridge in a network. The bridge with the lowest value has the highest priority and is the root. Possible values: 1 – 65,535. Default is 32,678.

Port Parameters (applied to a specified port within a VLAN)

- Path Cost – a parameter used to assign a higher or lower path cost to a port. Possible values: 1 – 65535. Default is (1000/Port Speed) for Half-Duplex ports and is (1000/Port Speed)/2 for Full-Duplex ports.
- Priority – value determines when a port will be rerouted in relation to other ports. Possible values: 0 – 255. Default is 128.

Configuring IP Sub-net, IPX Network and Protocol-Based VLANs

Protocol-based VLANS provide the ability to define separate broadcast domains for several unique Layer 3 protocols within a single Layer 2 broadcast domain. Some applications for this feature might include security between departments with unique protocol requirements. This feature enables you to limit the amount of broadcast traffic end-stations, servers, and routers need to accept.

NOTE: See “Configuring AppleTalk Cable VLANs” on page 16-29 for information about configuring an AppleTalk cable VLAN.

Example: Suppose you want to create four separate Layer 3 broadcast domains within a single Layer 2 STP broadcast domain:

- Two broadcast domains, one for each of two separate IP sub-nets
- One for IPX Network 1
- One for the Appletalk protocol

Also suppose you want a single router interface to be present within all of these separate broadcast domains, without using IEEE 802.1p VLAN tagging or any proprietary form of VLAN tagging.

Figure 16.11 shows this configuration.

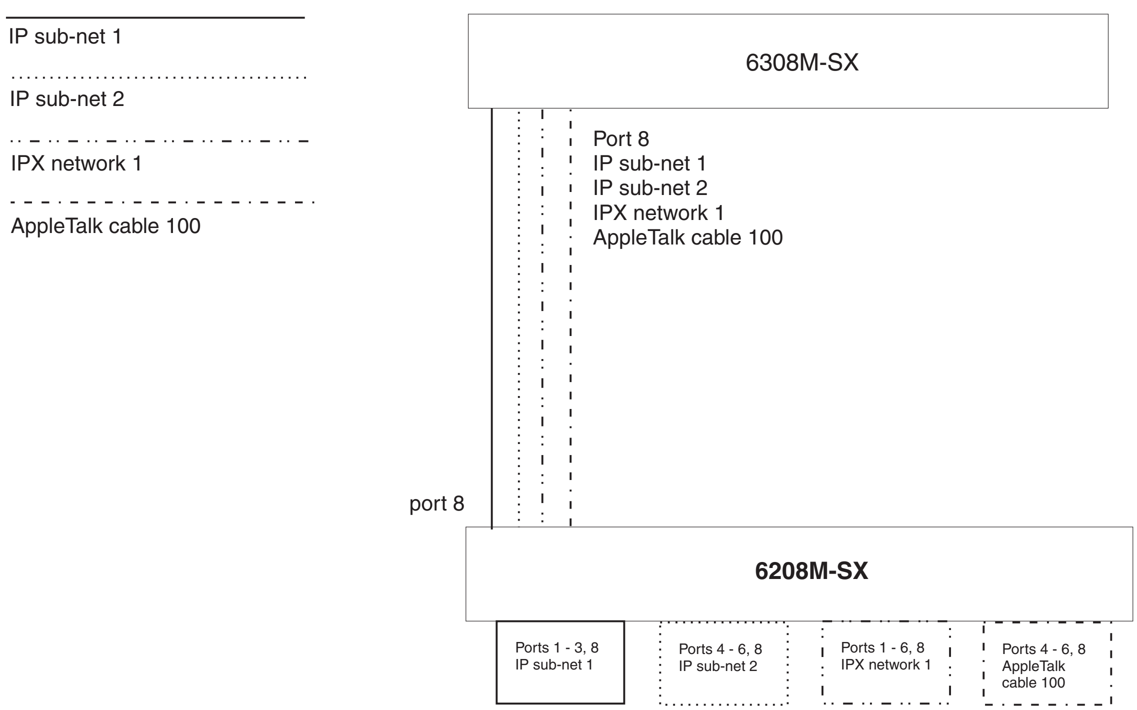


Figure 16.11 Protocol-based (Layer 3) VLANs

To configure the VLANs shown in Figure 16.11, use the following procedure.

USING THE CLI

1. To permanently assign ports 1 – 3 and port 8 to IP sub-net VLAN 1.1.1.0, enter the following commands

```
HP6208> en
No password has been assigned yet...
HP6208# config t
HP6208(config)#
HP6208(config)# ip-subnet 1.1.1.0/24 name Green
HP6208(config-ip-subnet)# no dynamic
HP6208(config-ip-subnet)# static ethernet 1 to 3 ethernet 8
```

2. To permanently assign ports 4 – 6 and port 8 to IP sub-net VLAN 1.1.2.0, enter the following commands:

```
HP6208(config-ip-subnet)# ip-subnet 1.1.2.0/24 name Yellow
HP6208(config-ip-subnet)# no dynamic
HP6208(config-ip-subnet)# static ethernet 4 to 6 ethernet 8
```

3. To permanently assign ports 1 – 6 and port 8 to IPX network 1 VLAN, enter the following commands:

```
HP6208(config-ip-subnet)# ipx-network 1 ethernet_802.3 name Blue
HP6208(config-ipx-network)# no dynamic
HP6208(config-ipx-network)# static ethernet 1 to 6 ethernet 8
HP6208(config-ipx-network)#
```

4. To permanently assign ports 4 – 6 and port 8 to Appletalk VLAN, enter the following commands:

```
HP6208(config-ipx-proto)# atalk-proto name Red
HP6208(config-atalk-proto)# no dynamic
HP6208(config-atalk-proto)# static ethernet 4 to 6 ethernet 8
HP6208(config-atalk-proto)# end
HP6208# write memory
HP6208#
```

Syntax: ip-subnet <ip-addr> <ip-mask> [name <string>]

Syntax: ipx-network <ipx-network-number> <frame-encapsulation-type> netbios-allow | netbios-disallow [name <string>]

Syntax: ip-proto | ipx-proto | atalk-proto | decnet-proto | netbios-proto | other-proto
static | exclude | dynamic
ethernet <portnum> [to <portnum>] [name <string>]

Routing Between VLANs using Virtual Interfaces (Routing Switches Only)

The routing switches offer the ability to create a virtual interface within a Layer 2 STP port-based VLAN or within each Layer 3 protocol, IP sub-net, or IPX network VLAN. This combination of multiple Layer 2 and/or Layer 3 broadcast domains and virtual interfaces are the basis for Integrated Switch Routing (ISR). ISR is very flexible and can solve many networking problems. The following example is meant to provide ideas by demonstrating some of the concepts of ISR.

Example: Suppose you want to move routing out to each of three buildings in a network. Remember that the only protocols present on VLAN 2 and VLAN 3 are IP and IPX. Therefore, you can eliminate tagged ports 25 and 26 from both VLAN 2 and VLAN 3 and create new tagged port-based VLANs to support separate IP sub-nets and IPX networks for each backbone link.

You also need to create unique IP sub-nets and IPX networks within VLAN 2 and VLAN 3 at each building. This will create a fully routed IP and IPX backbone for VLAN 2 and VLAN 3. However, VLAN 4 has no protocol restrictions across the backbone. In fact there are requirements for NetBIOS and DecNet to be bridged among the three building locations. The IP sub-net and IPX network that exists within VLAN 4 must remain a flat Layer 2 switched STP domain. You enable routing for IP and IPX on a virtual interface only on 9304 A. This will provide

the flat IP and IPX segment with connectivity to the rest of the network. Within VLAN 4 IP and IPX will follow the STP topology. All other IP sub-nets and IPX networks will be fully routed and have use of all paths at all times during normal operation.

Figure 16.12 shows the configuration described above.

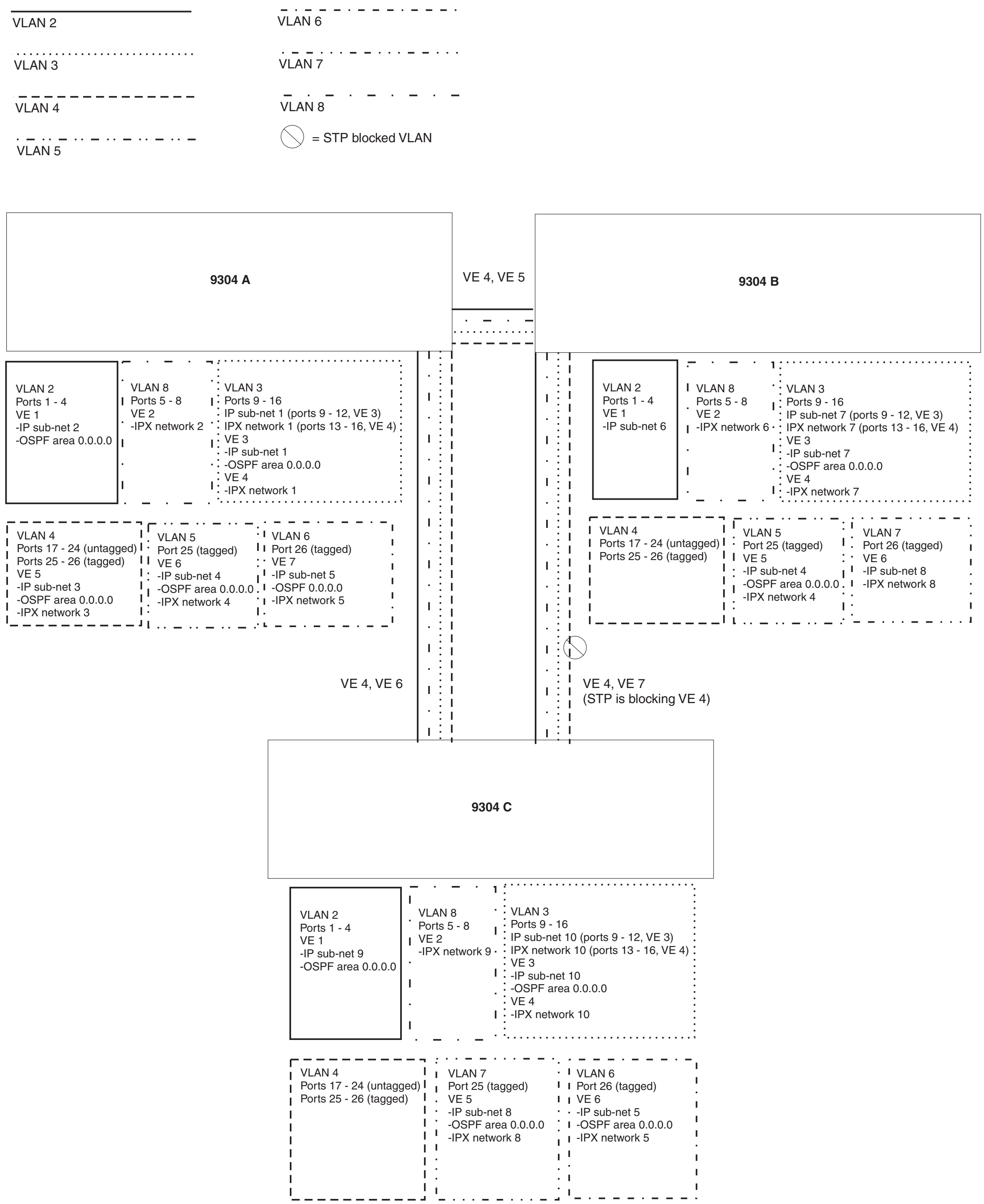


Figure 16.12 Routing between protocol-based VLANs

To configure the Layer 3 VLANs and virtual interfaces on the routing switches in Figure 16.12, use the following procedure.

USING THE CLI

Configuring 9304 A

Enter the following commands to configure 9304 A. The following commands enable OSPF or RIP routing and IPX routing.

```
HP9300> en
No password has been assigned yet...
HP9300# configure terminal
HP9300(config)# hostname HP9300-A
HP9300-A(config)# router ospf
HP9300-A(config-ospf-router)# area 0.0.0.0 normal
HP9300-A(config-ospf-router)# router ipx
ipx routing enabled for next power cycle.
Please save configuration to flash and reboot.
HP9300-A(config-ospf-router)#
```

The following commands create the port-based VLAN 2. In the previous example, an HP 9304M defined the router interfaces for VLAN 2. With ISR, routing for VLAN 2 is done locally within each HP 9304M. Therefore, there are two ways you can solve this problem. One way is to create a unique IP sub-net and IPX network VLAN, each with its own virtual interface and unique IP or IPX address within VLAN 2 on each HP 9304M. In this example, this is the configuration used for VLAN 3. The second way is to split VLAN 2 into two separate port-based VLANs and create a virtual interface within each port-based VLAN. Later in this example, this second option is used to create a port-based VLAN 8 to show that there are multiple ways to accomplish the same task with ISR.

You also need to create the Other-Protocol VLAN within port-based VLAN 2 and 8 to prevent unwanted protocols from being Layer 2 switched within port-based VLAN 2 or 8. Note that the only port-based VLAN that requires STP in this example is VLAN 4. You will need to configure the rest of the network to prevent the need to run STP.

```
HP9300-A(config-ospf-router)# vlan 2 name IP-Subnet_1.1.2.0/24
HP9300-A(config-vlan-2)# untag e1/1 to 1/4
HP9300-A(config-vlan-2)# no spanning-tree
HP9300-A(config-vlan-2)# router-interface ve1
HP9300-A(config-vlan-2)# other-proto name block_other_protocols
HP9300-A(config-vlan-other-proto)# no dynamic
HP9300-A(config-vlan-other-proto)# exclude e1/1 to 1/4
```

Once you have defined the port-based VLAN and created the virtual interface, you need to configure the virtual interface just as you would configure a physical interface.

```
HP9300-A(config-vlan-other-proto)# interface ve1
HP9300-A(config-vif-1)# ip address 1.1.2.1/24
HP9300-A(config-vif-1)# ip ospf area 0.0.0.0
```

Do the same thing for VLAN 8.

```
HP9300-A(config-vif-1)# vlan 8 name IPX_Network2
HP9300-A(config-vlan-8)# untag ethernet 1/5 to 1/8
HP9300-A(config-vlan-8)# no spanning-tree
HP9300-A(config-vlan-8)# router-interface ve 2
HP9300-A(config-vlan-8)# other-proto name block-other-protocols
HP9300-A(config-vlan-other-proto)# no dynamic
HP9300-A(config-vlan-other-proto)# exclude ethernet 1/5 to 1/8
HP9300-A(config-vlan-other-proto)# int ve2
HP9300-A(config-vif-2)# ipx network 2 ethernet_802.3
HP9300-A(config-vif-2)#
```

The next thing you need to do is create VLAN 3. This is very similar to the previous example with the addition of virtual interfaces to the IP sub-net and IPX network VLANs. Also there is no need to exclude ports from the IP sub-net and IPX network VLANs on the routing switch.

```
HP9300-A(config-vif-2)# vlan 3 name IP_Sub_&_IPX_Net_VLAN
HP9300-A(config-vlan-3)# untag e2/1 to 2/8
HP9300-A(config-vlan-3)# no spanning-tree
HP9300-A(config-vlan-3)# ip-subnet 1.1.1.0/24
HP9300-A(config-vlan-ip-subnet)# static e2/1 to 2/4
HP9300-A(config-vlan-ip-subnet)# router-interface ve3
HP9300-A(config-vlan-ip-subnet)# ipx-network 1 ethernet_802.3
HP9300-A(config-vlan-ipx-network)# static e2/5 to 2/8
HP9300-A(config-vlan-ipx-network)# router-interface ve4
HP9300-A(config-vlan-ipx-network)# other-proto name block-other-protocols
HP9300-A(config-vlan-other-proto)# exclude e2/1 to 2/8
HP9300-A(config-vlan-other-proto)# no dynamic
HP9300-A(config-vlan-other-proto)# interface ve 3
HP9300-A(config-vif-3)# ip addr 1.1.1.1/24
HP9300-A(config-vif-3)# ip ospf area 0.0.0.0
HP9300-A(config-vif-3)# int ve4
HP9300-A(config-vif-4)# ipx network 1 ethernet_802.3
HP9300-A(config-vif-4)#
```

Now configure VLAN 4. Remember this is a flat segment that, in the previous example, obtained its IP default gateway and IPX router services from an external HP 9304M. In this example, 9304 A will provide the routing services for VLAN 4. You also want to configure the STP priority for VLAN 4 to make 9304 A the root bridge for this VLAN.

```
HP9300-A(config-vif-4)# vlan 4 name Bridged_ALL_Protocols
HP9300-A(config-vlan-4)# untag ethernet 3/1 to 3/8
```

```
HP9300-A(config-vlan-4)# tag ethernet 4/1 to 4/2
HP9300-A(config-vlan-4)# spanning-tree
HP9300-A(config-vlan-4)# spanning-tree priority 500
HP9300-A(config-vlan-4)# router-interface ve5
HP9300-A(config-vlan-4)# int ve5
HP9300-A(config-vif-5)# ip address 1.1.3.1/24
HP9300-A(config-vif-5)# ip ospf area 0.0.0.0
HP9300-A(config-vif-5)# ipx network 3 ethernet_802.3
HP9300-A(config-vif-5)#
```

It is time to configure a separate port-based VLAN for each of the routed backbone ports (Ethernet 25 and 26). If you do not create a separate tagged port-based VLAN for each point-to-point backbone link, you need to include tagged interfaces for Ethernet 25 and 26 within VLANs 2, 3, and 8. This type of configuration makes the entire backbone a single STP domain for each VLAN 2, 3, and 8. This is the configuration used in the example in "Configuring IP Sub-net, IPX Network and Protocol-Based VLANs" on page 16-20. In this scenario, the virtual interfaces within port-based VLANs 2, 3, and 8 will be accessible using only one path through the network. The path that is blocked by STP is not available to the routing protocols until it is in the STP FORWARDING state.

```
HP9300-A(config-vif-5)# vlan 5 name Rtr_BB_to_Bldg.2
HP9300-A(config-vlan-5)# tag e4/1
HP9300-A(config-vlan-5)# no spanning-tree
HP9300-A(config-vlan-5)# router-interface ve6
HP9300-A(config-vlan-5)# vlan 6 name Rtr_BB_to_Bldg.1
HP9300-A(config-vlan-6)# tag ethernet 4/2
HP9300-A(config-vlan-6)# no spanning-tree
HP9300-A(config-vlan-6)# router-interface ve7
HP9300-A(config-vlan-6)# int ve6
HP9300-A(config-vif-6)# ip addr 1.1.4.1/24
HP9300-A(config-vif-6)# ip ospf area 0.0.0.0
HP9300-A(config-vif-6)# ipx network 4 ethernet_802.3
HP9300-A(config-vif-6)# int ve7
HP9300-A(config-vif-7)# ip addr 1.1.5.1/24
HP9300-A(config-vif-7)# ip ospf area 0.0.0.0
HP9300-A(config-vif-7)# ipx network 5 ethernet_802.3
HP9300-A(config-vif-7)#
```

This completes the configuration for 9304 A. The configuration for 9304 B and C is very similar except for a few issues.

- IP sub-nets and IPX networks configured on 9304 B and 9304 C must be unique across the entire network, except for the backbone port-based VLANs 5, 6, and 7 where the sub-net is the same but the IP address must change.
- There is no need to change the default priority of STP within VLAN 4.

- There is no need to include a virtual interface within VLAN 4.
- The backbone VLAN between 9304 B and 9304 C must be the same at both ends and requires a new VLAN ID. The VLAN ID for this port-based VLAN is VLAN 7.

Configuration for 9304 B

Enter the following commands to configure 9304 B.

```
HP9300> en
No password has been assigned yet...
HP9300# config t
HP9300(config)# hostname HP9300-B
HP9300-B(config)# router ospf
HP9300-B(config-ospf-router)# area 0.0.0.0 normal
HP9300-B(config-ospf-router)# router ipx
HP9300-B(config-ospf-router)# vlan 2 name IP-Subnet_1.1.6.0/24
HP9300-B(config-vlan-2)# untag e1/1 to 1/4
HP9300-B(config-vlan-2)# no spanning-tree
HP9300-B(config-vlan-2)# router-interface ve1
HP9300-B(config-vlan-2)# other-proto name block-other-protocols
HP9300-B(config-vlan-other-proto)# no dynamic
HP9300-B(config-vlan-other-proto)# exclude e1/1 to 1/4
HP9300-B(config-vlan-other-proto)# int ve1
HP9300-B(config-vif-1)# ip addr 1.1.6.1/24
HP9300-B(config-vif-1)# ip ospf area 0.0.0.0
HP9300-B(config-vif-1)# vlan 8 name IPX_Network6
HP9300-B(config-vlan-8)# untag e 1/5 to 1/8
HP9300-B(config-vlan-8)# no span
HP9300-B(config-vlan-8)# router-int ve2
HP9300-B(config-vlan-8)# other-proto name block-other-protocols
HP9300-B(config-vlan-other-proto)# no dynamic
HP9300-B(config-vlan-other-proto)# exclude e1/5 to 1/8
HP9300-B(config-vlan-other-proto)# int ve2
HP9300-B(config-vif-2)# ipx net 6 ethernet_802.3
HP9300-B(config-vif-2)# vlan 3 name IP_Sub_&_IPX_Net_VLAN
HP9300-B(config-vlan-3)# untag e2/1 to 2/8
HP9300-B(config-vlan-3)# no spanning-tree
HP9300-B(config-vlan-3)# ip-subnet 1.1.7.0/24
HP9300-B(config-vlan-ip-subnet)# static e2/1 to 2/4
HP9300-B(config-vlan-ip-subnet)# router-interface ve3
HP9300-B(config-vlan-ip-subnet)# ipx-network 7 ethernet_802.3
```

```
HP9300-B(config-vlan-ipx-network)# static e2/5 to 2/8
HP9300-B(config-vlan-ipx-network)# router-interface ve4
HP9300-B(config-vlan-ipx-network)# other-proto name block-other-protocols
HP9300-B(config-vlan-other-proto)# exclude e2/1 to 2/8
HP9300-B(config-vlan-other-proto)# no dynamic
HP9300-B(config-vlan-other-proto)# interface ve 3
HP9300-B(config-vif-3)# ip addr 1.1.7.1/24
HP9300-B(config-vif-3)# ip ospf area 0.0.0.0
HP9300-B(config-vif-3)# int ve4
HP9300-B(config-vif-4)# ipx network 7 ethernet_802.3
HP9300-B(config-vif-4)# vlan 4 name Bridged_ALL_Protocols
HP9300-B(config-vlan-4)# untag ethernet 3/1 to 3/8
HP9300-B(config-vlan-4)# tag ethernet 4/1 to 4/2
HP9300-B(config-vlan-4)# spanning-tree
HP9300-B(config-vlan-4)# vlan 5 name Rtr_BB_to_Bldg.1
HP9300-B(config-vlan-5)# tag e4/1
HP9300-B(config-vlan-5)# no spanning-tree
HP9300-B(config-vlan-5)# router-interface ve5
HP9300-B(config-vlan-5)# vlan 7 name Rtr_BB_to_Bldg.3
HP9300-B(config-vlan-7)# tag ethernet 4/2
HP9300-B(config-vlan-7)# no spanning-tree
HP9300-B(config-vlan-7)# router-interface ve6
HP9300-B(config-vlan-7)# int ve5
HP9300-B(config-vif-5)# ip addr 1.1.4.2/24
HP9300-B(config-vif-5)# ip ospf area 0.0.0.0
HP9300-B(config-vif-5)# ipx network 4 ethernet_802.3
HP9300-B(config-vif-5)# int ve6
HP9300-B(config-vif-6)# ip addr 1.1.8.1/24
HP9300-B(config-vif-6)# ip ospf area 0.0.0.0
HP9300-B(config-vif-6)# ipx network 8 ethernet_802.3
HP9300-B(config-vif-6)#
```

Configuration for 9304 C

Enter the following commands to configure 9304 C.

```
HP9300> en
No password has been assigned yet...
HP9300# config t
HP9300(config)# hostname HP9300-C
HP9300-C(config)# router ospf
```

```
HP9300-C(config-ospf-router)# area 0.0.0.0 normal
HP9300-C(config-ospf-router)# router ipx
HP9300-C(config-ospf-router)# vlan 2 name IP-Subnet_1.1.9.0/24
HP9300-C(config-vlan-2)# untag e1/1 to 1/4
HP9300-C(config-vlan-2)# no spanning-tree
HP9300-C(config-vlan-2)# router-interface ve1
HP9300-C(config-vlan-2)# other-proto name block-other-protocols
HP9300-C(config-vlan-other-proto)# no dynamic
HP9300-C(config-vlan-other-proto)# exclude e1/1 to 1/4
HP9300-C(config-vlan-other-proto)# int ve1
HP9300-C(config-vif-1)# ip addr 1.1.9.1/24
HP9300-C(config-vif-1)# ip ospf area 0.0.0.0
HP9300-C(config-vif-1)# vlan 8 name IPX_Network9
HP9300-C(config-vlan-8)# untag e 1/5 to 1/8
HP9300-C(config-vlan-8)# no span
HP9300-C(config-vlan-8)# router-int ve2
HP9300-C(config-vlan-8)# other-proto name block-other-protocols
HP9300-C(config-vlan-other-proto)# no dynamic
HP9300-C(config-vlan-other-proto)# exclude e1/5 to 1/8
HP9300-C(config-vlan-other-proto)# int ve2
HP9300-C(config-vif-2)# ipx net 9 ethernet_802.3
HP9300-C(config-vif-2)# vlan 3 name IP_Sub_&_IPX_Net_VLAN
HP9300-C(config-vlan-3)# untag e2/1 to 2/8
HP9300-C(config-vlan-3)# no spanning-tree
HP9300-C(config-vlan-3)# ip-subnet 1.1.10.0/24
HP9300-C(config-vlan-ip-subnet)# static e2/1 to 2/4
HP9300-C(config-vlan-ip-subnet)# router-interface ve3
HP9300-C(config-vlan-ip-subnet)# ipx-network 10 ethernet_802.3
HP9300-C(config-vlan-ipx-network)# static e2/5 to 2/8
HP9300-C(config-vlan-ipx-network)# router-interface ve4
HP9300-C(config-vlan-ipx-network)# other-proto name block-other-protocols
HP9300-C(config-vlan-other-proto)# exclude e2/1 to 2/8
HP9300-C(config-vlan-other-proto)# no dynamic
HP9300-C(config-vlan-other-proto)# interface ve 3
HP9300-C(config-vif-3)# ip addr 1.1.10.1/24
HP9300-C(config-vif-3)# ip ospf area 0.0.0.0
HP9300-C(config-vif-3)# int ve4
HP9300-C(config-vif-4)# ipx network 10 ethernet_802.3
```

```
HP9300-C(config-vif-4)# vlan 4 name Bridged_ALL_Protocols
HP9300-C(config-vlan-4)# untag ethernet 3/1 to 3/8
HP9300-C(config-vlan-4)# tag ethernet 4/1 to 4/2
HP9300-C(config-vlan-4)# spanning-tree
HP9300-C(config-vlan-4)# vlan 7 name Rtr_BB_to_Bldg.2
HP9300-C(config-vlan-7)# tag e4/1
HP9300-C(config-vlan-7)# no spanning-tree
HP9300-C(config-vlan-7)# router-interface ve5
HP9300-C(config-vlan-7)# vlan 6 name Rtr_BB_to_Bldg.3
HP9300-C(config-vlan-6)# tag ethernet 4/2
HP9300-C(config-vlan-6)# no spanning-tree
HP9300-C(config-vlan-6)# router-interface ve6
HP9300-C(config-vlan-6)# int ve5
HP9300-C(config-vif-5)# ip addr 1.1.8.2/24
HP9300-C(config-vif-5)# ip ospf area 0.0.0.0
HP9300-C(config-vif-5)# ipx network 8 ethernet_802.3
HP9300-C(config-vif-5)# int ve6
HP9300-C(config-vif-6)# ip addr 1.1.5.2/24
HP9300-C(config-vif-6)# ip ospf area 0.0.0.0
HP9300-C(config-vif-6)# ipx network 5 ethernet_802.3
HP9300-C(config-vif-6)#
```

Configuring AppleTalk Cable VLANs

You can configure up to eight AppleTalk cable VLANs within a port-based VLAN.

To configure an AppleTalk cable VLAN, you create a port-based VLAN, then create up to eight cable VLANs within the port-based VLAN. You create the AppleTalk cable VLAN by assigning a number to the VLAN, optionally naming the cable VLAN, assigning ports from the port-based VLAN, and specifying the router interface (virtual interface) on which the routing switch will send and receive traffic for the cable VLAN.

All the ports in an AppleTalk cable VLAN are within the same AppleTalk cable range. The routing switch switches traffic within the VLAN and routes traffic between VLANs.

Configuration Guidelines

Use the following guidelines when configuring AppleTalk cable VLANs:

- Up to eight AppleTalk cable VLANs are supported in a protocol-based VLAN. Each VLAN must be numbered from 1 – 8.
- Each AppleTalk cable VLAN can have only one router interface. The router interface must be a virtual interface.
- The AppleTalk cable VLANs cannot overlap. Thus, you cannot use the same port in more than one AppleTalk cable VLAN.
- You must add the ports to the AppleTalk cable VLAN using the static option. You cannot use the dynamic or exclude options.

- You cannot have an AppleTalk cable VLAN and an AppleTalk protocol VLAN in the same port-based VLAN. If you already have an AppleTalk protocol VLAN in the port-based VLAN, you must delete the AppleTalk protocol VLAN first, then configure the AppleTalk cable VLAN.

Configuration Example

Figure 3 shows an example of an HP 9308M routing switch with four AppleTalk cable VLANs configured on a single port-based VLAN. In this example, port-based VLAN 10 is configured, then AppleTalk cable VLANs are configured on ports on chassis modules 2 and 3. Each virtual interface (ve1, ve2, ve3, and ve4) is then configured with AppleTalk routing information for the cable VLAN.

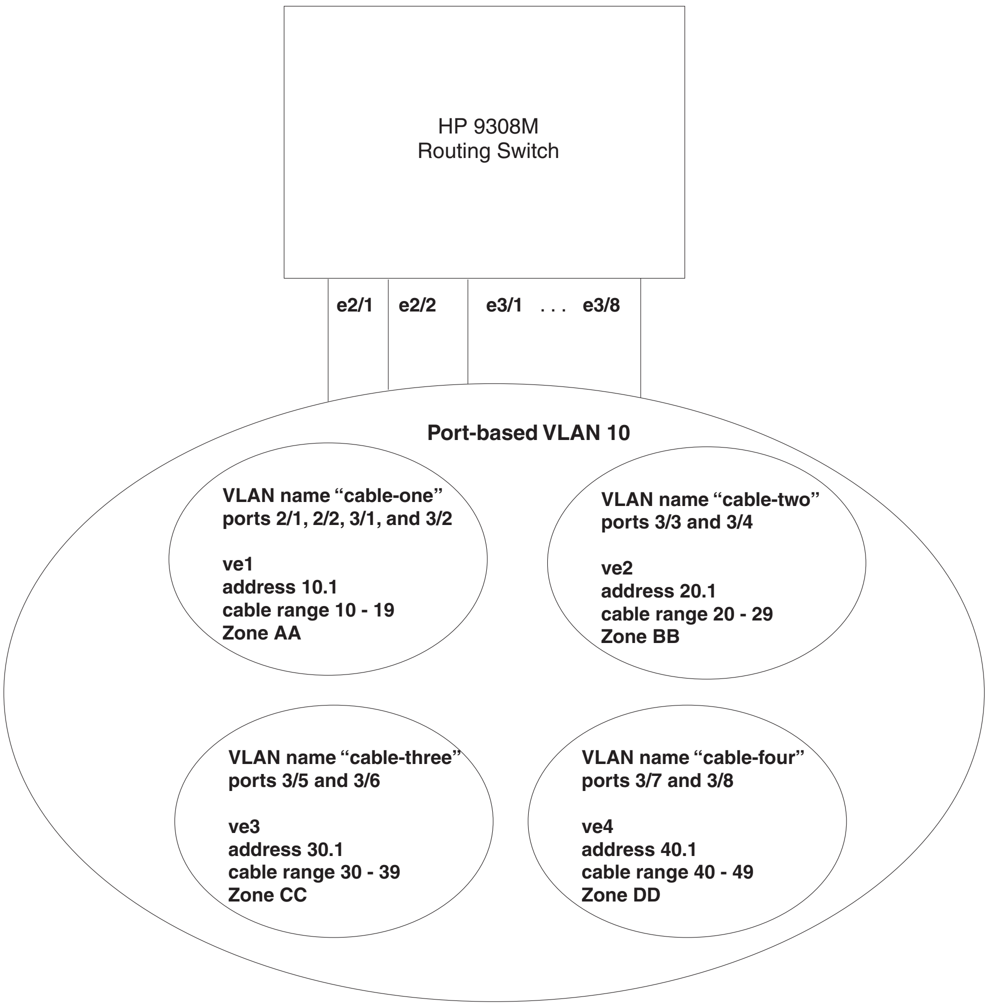


Figure 16.13 AppleTalk Cable VLANs

Configuring the VLANs

To configure the VLANs shown in Figure 3, enter the following CLI commands:

```
HP9300(config)# vlan 10 by port
HP9300(config-vlan-10)# untag ethe 2/1 to 2/2 ethe 3/1 to 3/8
```

The two commands above add port-based VLAN 10 and add ports 2/1, 2/2, and 3/1 – 3/16 to the VLAN. The **untag** command removes ports from the default VLAN and adds them to port-based VLAN 10. (The default VLAN contains all the ports in the system by default.) The **untag** command also allows the ports to process packets that do not contain 802.1p tagging.

The following commands add four AppleTalk cable VLANs, in groups of three commands each. The **appletalk-cable-vlan** command adds a cable VLAN and, with the optional **name** parameter, names the VLAN. The **static** command adds specific ports within the port-based VLAN to the AppleTalk cable VLAN. The **router-interface** command identifies virtual interface that connects to the AppleTalk cable range the VLAN is for.

```
HP9300(config-vlan-10)# appletalk-cable-vlan 1 name cable-one
HP9300(config-vlan-10)# static ethe 2/1 to 2/2 ethe 3/1 to 3/2
HP9300(config-vlan-10)# router-interface ve 1
HP9300(config-vlan-10)# appletalk-cable-vlan 2 name cable-two
HP9300(config-vlan-10)# static ethe 3/3 to 3/4
HP9300(config-vlan-10)# router-interface ve 2
HP9300(config-vlan-10)# appletalk-cable-vlan 3 name cable-three
HP9300(config-vlan-10)# static ethe 3/5 to 3/6
HP9300(config-vlan-10)# router-interface ve 3
HP9300(config-vlan-10)# appletalk-cable-vlan 4 name cable-four
HP9300(config-vlan-10)# static ethe 3/7 to 3/8
HP9300(config-vlan-10)# router-interface ve 4
```

Syntax: appletalk-cable-vlan <vlan-id> [name <string>]

The <vlan-id> can be from 1 – 8.

The **name** <string> parameter specifies a name and can be a string up to 32 characters long.

Configuring the Router Interfaces

The following commands configure the router interfaces (virtual interfaces) associated with the AppleTalk cable VLANs. The **interface ve** commands add the virtual interfaces to the system. (The **router-interface** commands above refer to these interfaces but do not add them. You must add the interfaces using the **interface ve** command.)

For each virtual interface, additional commands configure the AppleTalk routing parameters for the interface. Notice that each virtual interface has a separate set of routing parameters. The routing parameters on each virtual interface are independent of the routing parameters on other virtual interfaces. Since each AppleTalk cable VLAN is associated with a separate virtual interface, each AppleTalk cable VLAN has a distinct set of routing parameters, separate from the routing parameters on other AppleTalk VLANs. In effect, each virtual interface contains a separate AppleTalk routing switch.

The **appletalk address** command configures the AppleTalk interface address on the virtual interface. The **appletalk cable-range** command specifies the cable range for the network. The **appletalk routing** command enables AppleTalk routing on the virtual interface. The **zone-name** commands add zones to the network. For information about the AppleTalk routing commands, see the "Configuring AppleTalk" on page 15-1.

The **write memory** command at the end of the example saves the configuration to the startup-config file.

```
HP9300(config-vlan-10)# interface ve 1
HP9300(config-vif-1)# appletalk cable-range 10 - 19
HP9300(config-vif-1)# appletalk address 10.1
HP9300(config-vif-1)# appletalk zone-name AA
HP9300(config-vif-1)# appletalk routing
HP9300(config-vif-1)# interface ve 2
HP9300(config-vif-2)# appletalk cable-range 20 - 29
HP9300(config-vif-2)# appletalk address 20.1
```

```
HP9300(config-vif-2)# appletalk zone-name BB
HP9300(config-vif-2)# appletalk routing
HP9300(config-vif-2)# interface ve 3
HP9300(config-vif-3)# appletalk cable-range 30 - 39
HP9300(config-vif-3)# appletalk address 30.1
HP9300(config-vif-3)# appletalk zone-name CC
HP9300(config-vif-3)# appletalk routing
HP9300(config-vif-3)# interface ve 4
HP9300(config-vif-4)# appletalk cable-range 40 - 49
HP9300(config-vif-4)# appletalk address 40.1
HP9300(config-vif-4)# appletalk zone-name DD
HP9300(config-vif-4)# appletalk routing
HP9300(config-vif-4)# write memory
```

Configuring Protocol VLANs With Dynamic Ports

The configuration examples for protocol VLANs in the sections above show how to configure the VLANs using static ports. You also can configure the following types of protocol VLANs with dynamic ports:

- AppleTalk protocol
- IP protocol
- IPX protocol
- IP sub-net
- IPX network

NOTE: The software does not support dynamically adding ports to AppleTalk cable VLANs. Conceptually, an AppleTalk cable VLAN comprises a single network cable, connected to a single port. Therefore, dynamic addition and removal of ports is not applicable.

NOTE: You cannot route to or from protocol VLANs with dynamically added ports.

Aging of Dynamic Ports

When you add the ports to the VLAN, the software automatically adds them all to the VLAN. However, dynamically added ports age out. If the age time for a dynamic port expires, the software removes the port from the VLAN. If that port receives traffic for the IP sub-net or IPX network, the software adds the port to the VLAN again and starts the aging timer over. Each time the port receives traffic for the VLAN's IP sub-net or IPX network, the aging timer starts over.

Dynamic ports within any protocol VLAN age out after 10 minutes, if no member protocol traffic is received on a port within the VLAN. The aged out port, however, remains as a candidate dynamic port for that VLAN. The port becomes active in the VLAN again if member protocol traffic is received on that port.

Once a port is re-activated, the aging out period for the port is reset to 20 minutes. Each time a member protocol packet is received by a candidate dynamic port (aged out port) the port becomes active again and the aging out period is reset for 20 minutes.

Configuration Guidelines

- You cannot dynamically add a port to a protocol VLAN if the port has any routing configuration parameters. For example, the port cannot have a virtual interface, IP sub-net address, IPX network address, or AppleTalk network address configured on it.
- Once you dynamically add a port to a protocol VLAN, you cannot configure routing parameters on the port.
- Dynamic VLAN ports are not required or supported on AppleTalk cable VLANs.

Configuring an IP, IPX, or AppleTalk Protocol VLAN with Dynamic Ports

To configure an IP, IPX, or AppleTalk protocol VLAN with dynamic ports, use one of the following methods.

USING THE CLI

To configure port-based VLAN 10, then configure an IP protocol VLAN within the port-based VLAN with dynamic ports, enter the following commands such as the following:

```
HP9300(config)# vlan 10 by port
HP9300(config-vlan-10)# untag ethernet 1/1 to 1/6
added untagged port ethe 1/1 to 1/6 to port-vlan 30.
HP9300(config-vlan-10)# ip-proto name IP_Prot_VLAN
HP9300(config-vlan-10)# dynamic
HP9300(config)# write memory
```

Syntax: vlan <vlan-id> by port [name <string>]

Syntax: untagged ethernet <portnum> to <portnum>

Or

Syntax: untagged ethernet <portnum> ethernet <portnum>

NOTE: Use the first **untagged** command for adding a range of ports. Use the second command for adding separate ports (not in a range).

Syntax: ip-proto [name <string>]

Syntax: ipx-proto [name <string>]

Syntax: appletalk-cable-vlan <num> [name <string>]

Syntax: dynamic

The procedure is similar for IPX and AppleTalk protocol VLANs. Enter **ipx-proto** or **atalk-proto** instead of **ip-proto**.

Configuring an IP Sub-Net VLAN with Dynamic Ports

To configure an IP sub-net VLAN with dynamic ports, use one of the following methods.

USING THE CLI

To configure port-based VLAN 10, then configure an IP sub-net VLAN within the port-based VLAN with dynamic ports, enter commands such as the following:

```
HP9300(config)# vlan 10 by port name IP_VLAN
HP9300(config-vlan-10)# untag ethernet 1/1 to 1/6
added untagged port ethe 1/1 to 1/6 to port-vlan 10.
HP9300(config-vlan-10)# ip-subnet 1.1.1.0/24 name Mktg-LAN
```

```
HP9300(config-vlan-10)# dynamic
HP9300(config)# write memory
```

These commands create a port-based VLAN on chassis ports 1/1 – 1/6 named “Mktg-LAN”, configure an IP subnet VLAN within the port-based VLAN, and then add ports from the port-based VLAN dynamically.

Syntax: vlan <vlan-id> by port [name <string>]

Syntax: untagged ethernet <portnum> to <portnum>

Or

Syntax: untagged ethernet <portnum> ethernet <portnum>

NOTE: Use the first **untagged** command for adding a range of ports. Use the second command for adding separate ports (not in a range).

Syntax: ip-subnet <ip-addr> <ip-mask> [name <string>]

Or

Syntax: ip-subnet <ip-addr>/<mask-bits> [name <string>]

Syntax: dynamic

Configuring an IPX Network VLAN with Dynamic Ports

To configure an IPX network VLAN with dynamic ports, use one of the following methods.

USING THE CLI

To configure port-based VLAN 20, then configure an IPX network VLAN within the port-based VLAN with dynamic ports, enter commands such as the following:

```
HP9300(config)# vlan 20 by port name IPX_VLAN
HP9300(config-vlan-10)# untag ethernet 2/1 to 2/6
added untagged port ethe 2/1 to 2/6 to port-vlan 20.
HP9300(config-vlan-10)# ipx-network abcd ethernet_ii name Eng-LAN
HP9300(config-vlan-10)# dynamic
HP9300(config)# write memory
```

These commands create a port-based VLAN on chassis ports 2/1 – 2/6 named “Eng-LAN”, configure an IPX network VLAN within the port-based VLAN, and then add ports from the port-based VLAN dynamically.

Syntax: vlan <vlan-id> by port [name <string>]

Syntax: untagged ethernet <portnum> to <portnum>

Or

Syntax: untagged ethernet <portnum> ethernet <portnum>

NOTE: Use the first **untagged** command for adding a range of ports. Use the second command for adding separate ports (not in a range).

Syntax: ipx-network <network-addr> ethernet_ii | ethernet_802.2 | ethernet_802.3 | ethernet_snap [name <string>]

Syntax: dynamic

Configuring Uplink Ports Within a Port-Based VLAN

You can configure a subset of the ports in a port-based VLAN as uplink ports. When you configure uplink ports in a port-based VLAN, the device sends all broadcast and unknown-unicast traffic from a port in the VLAN to the uplink ports, but not to other ports within the VLAN. Thus, the uplink ports provide tighter broadcast control within the VLAN.

For example, if two ports within a port-based VLAN are Gigabit ports attached to the network and the other ports in the VLAN are 10/100 ports attached to clients, you can configure the two ports attached to the network as uplink ports. In this configuration, broadcast and unknown-unicast traffic in the VLAN does not go to all ports in the VLAN. The traffic goes only to the uplink ports. The clients on the network do not receive broadcast and unknown-unicast traffic from other ports, including other clients.

To configure uplink ports in a port-based VLAN, use the following CLI method.

USING THE CLI

To configure a port-based VLAN containing uplink ports, enter commands such as the following:

```
HP9300(config)# vlan 10 by port
HP9300(config-vlan-10)# untag ethernet 1/1 to 1/24
HP9300(config-vlan-10)# untag ethernet 2/1 to 2/2
HP9300(config-vlan-10)# uplink-switch ethernet 2/1 to 2/2
```

Syntax: [no] uplink-switch ethernet <portnum> [to <portnum> | ethernet <portnum>]

In this example, 24 ports on a 10/100 module and two Gigabit ports on a Gigabit module are added to port-based VLAN 10. The two Gigabit ports are then configured as uplink ports.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure uplink ports in a port-based VLAN using the Web management interface.

Configuring the Same IP Sub-Net Address on Multiple Port-Based VLANs

For a device to route between port-based VLANs, you must add a virtual interface to each VLAN. Generally, you also configure a unique IP sub-net address on each virtual interface. For example, if you have three port-based VLANs, you add a virtual interface to each VLAN, then add a separate IP sub-net address to each virtual interface. The IP address on each of the virtual interfaces must be in a separate sub-net. The device routes Layer 3 traffic between the sub-nets using the sub-net addresses.

NOTE: This feature applies only to the HP 9304M, HP 9308M, and HP 6308M-SX routing switches.

Figure 16.14 shows an example of this type of configuration.

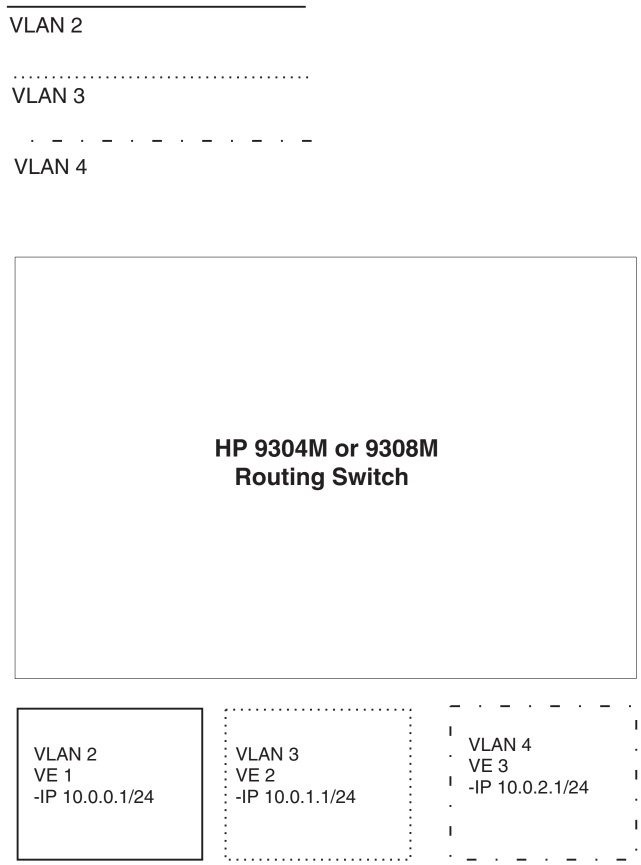


Figure 16.14   Multiple port-based VLANs with separate protocol addresses

As shown in this example, each VLAN has a separate IP sub-net address. If you need to conserve IP sub-net addresses, you can configure multiple VLANs with the same IP sub-net address, as shown in Figure 16.15.

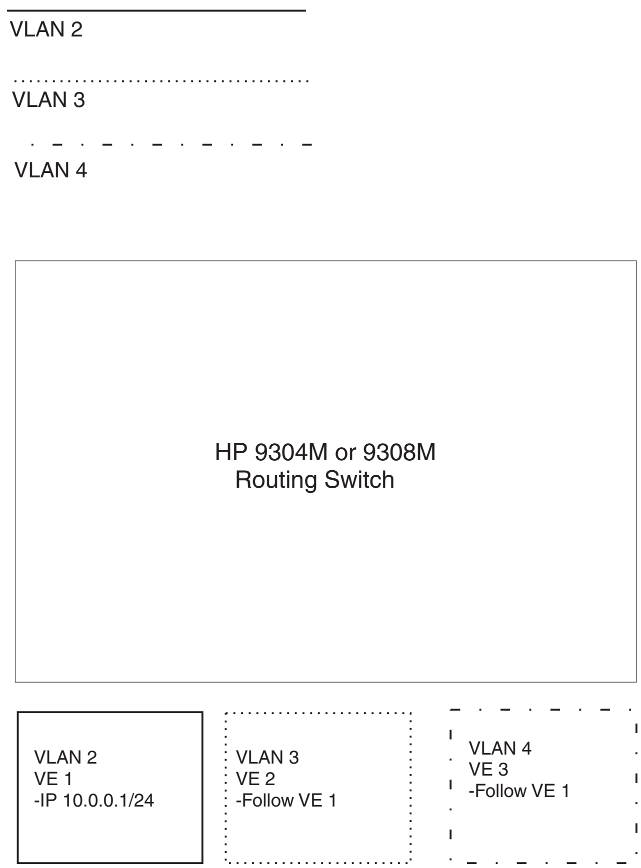


Figure 16.15 Multiple port-based VLANs with the same protocol address

Each VLAN still requires a separate virtual interface. However, all three VLANs now use the same IP sub-net address.

In addition to conserving IP sub-net addresses, this feature allows containment of Layer 2 broadcasts to segments within an IP sub-net. For ISP environments where the same IP sub-net is allocated to different customers, placing each customer in a separate VLAN allows all customers to share the IP sub-net address, while at the same time isolating them from one another's Layer 2 broadcasts.

NOTE: You can provide redundancy to an IP sub-net address that contains multiple VLANs using a pair of routing switches configured for VRRP (Virtual Router Redundancy Protocol) or SRP (Standby Router Protocol).

The device performs proxy Address Resolution Protocol (ARP) for hosts that want to send IP traffic to hosts in other VLANs that are sharing the same IP sub-net address. If the source and destination hosts are in the same VLAN, the device does not need to use ARP.

- If a host attached to one VLAN sends an ARP message for the MAC address of a host in one of the other VLANs using the same IP sub-net address, the device performs a proxy ARP on behalf of the other host. The device then replies to the ARP by sending the virtual interface MAC address. The device uses the same MAC address for all virtual interfaces.

  When the host that sent the ARP then sends a unicast packet addressed to the virtual interface's MAC address, the routing switch switches the packet on Layer 3 to the destination host on the VLAN.

NOTE: If the device's ARP table does not contain the requested host, the device forwards the ARP request on Layer 2 to the same VLAN as the one that received the ARP request. Then the device sends an ARP for the destination to the other VLANs that are using the same IP sub-net address.

- If the destination is in the same VLAN as the source, the device does not need to perform a proxy ARP.

To configure multiple VLANs to use the same IP sub-net address:

- Configure each VLAN, including adding tagged or untagged ports.
- Configure a separate virtual interface for each VLAN, but do not add an IP sub-net address to more than one of the virtual interfaces.
- Configure the virtual interfaces that do not have the IP sub-net address to "follow" the virtual interface that does have the address.

USING THE CLI

To configure the VLANs shown in Figure 16.15, you could enter the following commands.

```
HP9300(config)# vlan 1 by port
HP9300(config-vlan-1)# untag ethernet 1/1
HP9300(config-vlan-1)# tag ethernet 1/8
HP9300(config-vlan-1)# router-interface ve 1
```

Syntax: ip follow ve <num>

The commands above configure port-based VLAN 1. The VLAN has one untagged port (1/1) and a tagged port (1/8). In this example, all three VLANs contain port 1/8 so the port must be tagged to allow the port to be in multiple VLANs. You can configure VLANs to share a Layer 3 protocol interface regardless of tagging. A combination of tagged and untagged ports is shown in this example to demonstrate that sharing the interface does not change other VLAN features.

Notice that each VLAN still requires a unique virtual interface.

The following commands configure port-based VLANs 2 and 3.

```
HP9300(config-vlan-1)# vlan 2 by port
HP9300(config-vlan-2)# untag ethernet 1/2
HP9300(config-vlan-2)# tag ethernet 1/8
HP9300(config-vlan-2)# router-interface ve 2
HP9300(config-vlan-2)# vlan 3 by port
HP9300(config-vlan-3)# untag ethernet 1/5 to 1/6
HP9300(config-vlan-3)# tag ethernet 1/8
HP9300(config-vlan-3)# router-interface ve 3
```

The following commands configure an IP sub-net address on virtual interface 1.

```
HP9300(config-vlan-3)# interface ve 1
HP9300(config-vif-1)# ip address 10.0.0.1/24
```

The following commands configure virtual interfaces 2 and 3 to "follow" the IP sub-net address configured on virtual interface 1.

```
HP9300(config-vif-1)# interface ve 2
HP9300(config-vif-2)# ip follow ve 1
HP9300(config-vif-2)# interface ve 3
```

```
HP9300(config-vif-3)# ip follow ve 1
```

NOTE: Since virtual interfaces 2 and 3 do not have their own IP sub-net addresses but instead are “following” virtual interface 1’s IP address, you still can configure an IPX or AppleTalk interface on virtual interfaces 2 and 3.

Configuring VLAN Groups and Virtual Interface Groups

To simplify configuration when you have many VLANs with the same configuration, you can configure VLAN groups and virtual interface groups.

NOTE: VLAN groups and virtual interface groups are supported only on the chassis-based routing switches.

When you create a VLAN group, the VLAN parameters you configure for the group apply to all the VLANs within the group. Additionally, you can easily associate the same IP sub-net interface with all the VLANs in a group by configuring a virtual interface group with the same ID as the VLAN group.

- The VLAN group feature allows you to create multiple port-based VLANs with identical port members. Since the member ports are shared by all the VLANs within the group, you must add the ports as tagged ports. This feature not only simplifies VLAN configuration but also allows you to have a large number of identically configured VLANs in a startup-config file on the device’s flash memory module. Normally, a startup-config file with a large number of VLANs might not fit on the flash memory module. By grouping the identically configured VLANs, you can conserve space in the startup-config file so that it fits on the flash memory module.
- The virtual interface group feature is useful when you want to configure the same IP sub-net address on all the port-based VLANs within a VLAN group. You can configure a virtual interface group only after you configure a VLAN group with the same ID. The virtual interface group automatically applies to the VLANs in the VLAN group that has the same ID and cannot be applied to other VLAN groups or to individual VLANs.

You can create up to 32 VLAN groups and 32 virtual interface groups. A virtual interface group always applies only to the VLANs in the VLAN group with the same ID.

NOTE: Depending on the size of the VLAN ID range you want to use for the VLAN group, you might need to allocate additional memory for VLANs. On routing switches, if you allocate additional memory for VLANs, you also need to allocate the same amount of memory for virtual interfaces. This is true regardless of whether you use the virtual interface groups. To allocate additional memory, see “Allocating Memory for More VLANs or Virtual Interfaces” on page 16-41.

Configuring a VLAN Group

To configure a VLAN group, use the following CLI method.

USING THE CLI

To configure a VLAN group, enter commands such as the following:

```
HP9300(config)# vlan-group 1 vlan 2 to 1000
HP9300(config-vlan-group-1)# tagged 1/1 to 1/2
```

The first command in this example begins configuration for VLAN group 1, and assigns VLANs 2 through 1000 to the group. The second command adds ports 1/1 and 1/2 as tagged ports. Since all the VLANs in the group share the ports, you must add the ports as tagged ports.

Syntax: vlan-group <num> vlan <vlan-id> to <vlan-id>

Syntax: tagged ethernet <portnum> [to <portnum> | ethernet <portnum>]

The <num> parameter with the **vlan-group** command specifies the VLAN group ID and can be from 1 – 32. The **vlan** <vlan-id> **to** <vlan-id> parameters specify a contiguous range (a range with no gaps) of individual VLAN IDs. Specify the low VLAN ID first and the high VLAN ID second. The command adds all the specified VLANs to the VLAN group.

NOTE: The device's memory must be configured to contain at least the number of VLANs you specify for the higher end of the range. For example, if you specify 2048 as the VLAN ID at the high end of the range, you first must increase the memory allocation for VLANs to 2048 or higher. Additionally, on routing switches, if you allocate additional memory for VLANs, you also need to allocate the same amount of memory for virtual interfaces, before you configure the VLAN groups. This is true regardless of whether you use the virtual interface groups. The memory allocation is required because the VLAN groups and virtual interface groups have a one-to-one mapping. See "Allocating Memory for More VLANs or Virtual Interfaces" on page 16-41.

If a VLAN within the range you specify is already configured, the CLI does not add the group but instead displays an error message. In this case, create the group by specifying a valid contiguous range. Then add more VLANs to the group after the CLI changes to the configuration level for the group. See the following example.

You can add and remove individual VLANs or VLAN ranges from at the VLAN group configuration level. For example, if you want to add VLANs 1001 and 1002 to VLAN group 1 and remove VLANs 900 through 1000, enter the following commands:

```
HP9300(config-vlan-group-1)# add-vlan 1001 to 1002
HP9300(config-vlan-group-1)# remove-vlan 900 to 1000
```

Syntax: add-vlan <vlan-id> [to <vlan-id>]

Syntax: remove-vlan <vlan-id> [to <vlan-id>]

USING THE WEB MANAGEMENT INTERFACE

You cannot configure this feature using the Web management interface.

Configuring a Virtual Interface Group

A virtual interface group allows you to associate the same IP sub-net interface with multiple port-based VLANs. For example, if you associate a virtual interface group with a VLAN group, all the VLANs in the group have the IP interface of the virtual interface group.

To configure a virtual interface group, use the following CLI method.

NOTE: When you configure a virtual interface group, all members of the group have the same IP sub-net address. This feature is useful in collocation environments where the device has many IP addresses and you want to conserve the IP address space.

USING THE CLI

To configure a virtual interface group, enter commands such as the following:

```
HP9300(config)# vlan-group 1
HP9300(config-vlan-group-1)# group-router-interface
HP9300(config-vlan-group-1)# exit
HP9300(config)# interface group-ve 1
HP9300(config-vif-group-1)# ip address 10.10.10.1/24
```

These commands enable VLAN group 1 to have a group virtual interface, then configure virtual interface group 1. The software always associates a virtual interface group only with the VLAN group that has the same ID. In this example, the VLAN group ID is 1, so the corresponding virtual interface group also must have ID 1.

Syntax: group-router-interface

Syntax: interface group-ve <num>

Syntax: [no] ip address <ip-addr> <ip-mask> [secondary]

or

Syntax: [no] ip address <ip-addr>/<mask-bits> [secondary]

The **router-interface-group** command enables a VLAN group to use a virtual interface group. Enter this command at the configuration level for the VLAN group. This command configures the VLAN group to use the

virtual interface group that has the same ID as the VLAN group. You can enter this command when you configure the VLAN group for the first time or later, after you have added tagged ports to the VLAN and so on.

The <num> parameter in the **interface group-ve** <num> command specifies the ID of the VLAN group with which you want to associate this virtual interface group. The VLAN group must already be configured and enabled to use a virtual interface group. The software automatically associates the virtual interface group with the VLAN group that has the same ID. You can associate a virtual interface group only with the VLAN group that has the same ID.

The syntax and usage for the **ip address** command is the same as when you use the command at the interface level to add an IP interface.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure this feature using the Web management interface.

Displaying the VLAN Group and Virtual Interface Group Information

To verify configuration of VLAN groups and virtual interface groups, display the running-config file. If you have saved the configuration to the startup-config file, you also can verify the configuration by displaying the startup-config file. The following example shows the running-config information for the VLAN group and virtual interface group configured in the previous examples. The information appears in the same way in the startup-config file.

```
HP9300(config)# show running-config
```

lines not related to the VLAN group omitted...

```
vlan-group 1 vlan 2 to 900
 add-vlan 1001 to 1002
 tagged ethe 1/1 to 1/2
 router-interface-group
```

lines not related to the virtual interface group omitted...

```
interface group-ve 1
 ip address 10.10.10.1 255.255.255.0
```

NOTE: If you have enabled display of sub-net masks in CIDR notation, the IP address information is shown as follows: 10.10.10.1/24.

Allocating Memory for More VLANs or Virtual Interfaces

HP 9304M or HP 9308M routing switches support up to 4095 VLANs and 4095 virtual interfaces.

The number of VLANs and virtual interfaces supported depends on the amount of DRAM memory on the management module. Table 16.1 lists the default and configurable maximum number of VLANs.

Table 16.1: VLAN and Virtual Interface Support

Product	Default Maximum	Configurable Maximum
HP 9304M or HP 9308M with 128MB management module	255	2048

NOTE: If many of your VLANs will have an identical configuration, you might want to configure VLAN groups and virtual interface groups after you increase the system capacity for VLANs and virtual interfaces. See “Configuring VLAN Groups and Virtual Interface Groups” on page 16-39.

Increasing the Number of VLANs You Can Configure

To increase the size of the VLAN table, which determines how many VLANs you can configure, use either of the following methods.

NOTE: Although you can specify up to 4095 VLANs, you can configure only 4094 VLANs. VLAN ID 4094 is reserved for use by the Single Spanning Tree feature.

USING THE CLI

To increase the maximum number of VLANs you can configure, enter commands such as the following at the global CONFIG level of the CLI:

```
HP9300(config)# system-max vlan 2048
HP9300(config)# write memory
HP9300(config)# end
HP9300# reload
```

Syntax: system-max vlan <num>

The <num> parameter indicates the maximum number of VLANs. The range of valid values depends on the device you are configuring. See Table 16.1.

USING THE WEB MANAGEMENT INTERFACE

To modify a table size using the Web management interface:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Select the Max-Parameter link to display the Configure System Parameter Maximum Value table. This table lists the settings and valid ranges for all the configurable table sizes on the device.
3. Click the Modify button next to the row for the parameter (in this case, “vlan”).
4. Enter the new value for the table size. The value you enter specifies the maximum number of entries the table can hold.
5. Click Apply to save the changes to the device’s running-config.
6. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.
7. Click on the plus sign next to Command in the tree view to list the command options.
8. Select the Reload link and select Yes when the Web management interface asks you whether you really want to reload the software. Changes to cache and table sizes do not take effect until you reload the software.

Increasing the Number of Virtual Interfaces You Can Configure

To increase the size of the virtual interface table, which determines how many virtual interfaces you can configure, use either of the following methods.

USING THE CLI

To increase the maximum number of virtual interfaces you can configure, enter commands such as the following at the global CONFIG level of the CLI:

```
HP9300(config)# system-max virtual-interface 4095
HP9300(config)# write memory
HP9300(config)# end
```

```
HP9300# reload
```

Syntax: system-max virtual-interface <num>

The <num> parameter indicates the maximum number of virtual interfaces. The range of valid values depends on the device you are configuring. See Table 16.1.

USING THE WEB MANAGEMENT INTERFACE

See the Web management procedure for increasing the VLAN table size, in "Increasing the Number of VLANs You Can Configure" on page 16-42.

Configuring Super Aggregated VLANs

You can aggregate multiple VLANs within another VLAN. This feature allows you to construct Layer 2 paths and channels. This feature is particularly useful for Virtual Private Network (VPN) applications in which you need to provide a private, dedicated Ethernet connection for an individual client to transparently reach its sub-net across multiple networks.

Conceptually, the paths and channels are similar to Asynchronous Transfer Mode (ATM) paths and channels. A path contains multiple channels, each of which is a dedicated circuit between two end points. The two devices at the end points of the channel appear to each other to be directly attached. The network that connects them is transparent to the two devices.

You can aggregate up to 4094 VLANs within another VLAN. This provides a total VLAN capacity on one HP device of 16,760,836 channels (4094 * 4094).

The devices connected through the channel are not visible to devices in other channels. Therefore, each client has a private link to the other side of the channel.

The feature allows point-to-point and point-to-multipoint connections.

Figure 16.16 shows a conceptual picture of the service that aggregated VLANs provide. Aggregated VLANs provide a path for multiple client channels. The channels do not receive traffic from other channels. Thus, each channel is a private link.

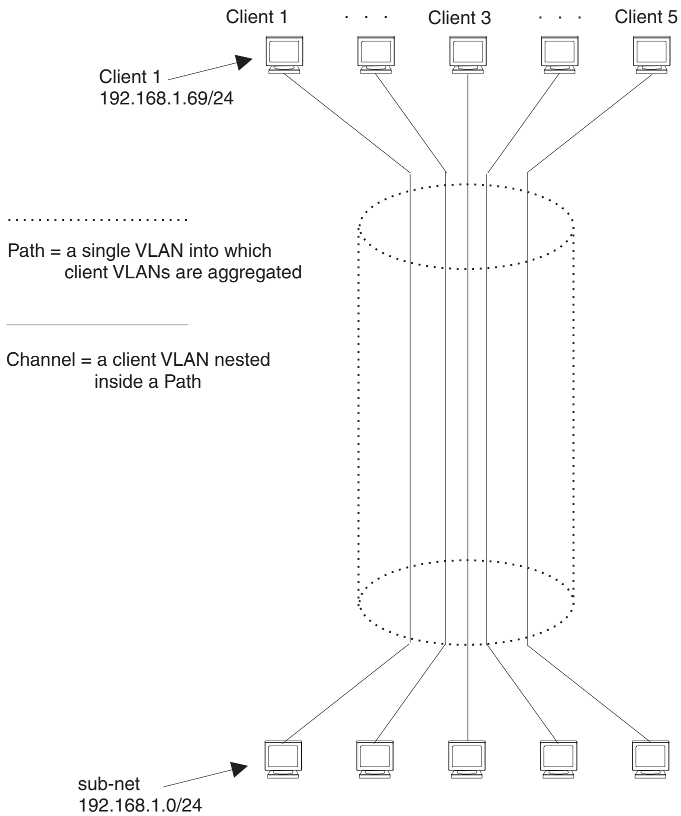


Figure 16.16 Conceptual Model of the Super Aggregated VLAN Application

Each client connected to the edge device is in its own port-based VLAN, which is like an ATM channel. All the clients' VLANs are aggregated by the edge device into a single VLAN for connection to the core. The single VLAN that aggregates the clients' VLANs is like an ATM path.

The device that aggregates the VLANs forwards the aggregated VLAN traffic through the core. The core can consist of multiple devices that forward the aggregated VLAN traffic. The edge device at the other end of the core separates the aggregated VLANs into the individual client VLANs before forwarding the traffic. The edge devices forward the individual client traffic to the clients. For the clients' perspective, the channel is a direct point-to-point link.

Figure 16.17 shows an example application that uses aggregated VLANs. This configuration includes the client connections shown in Figure 16.16.

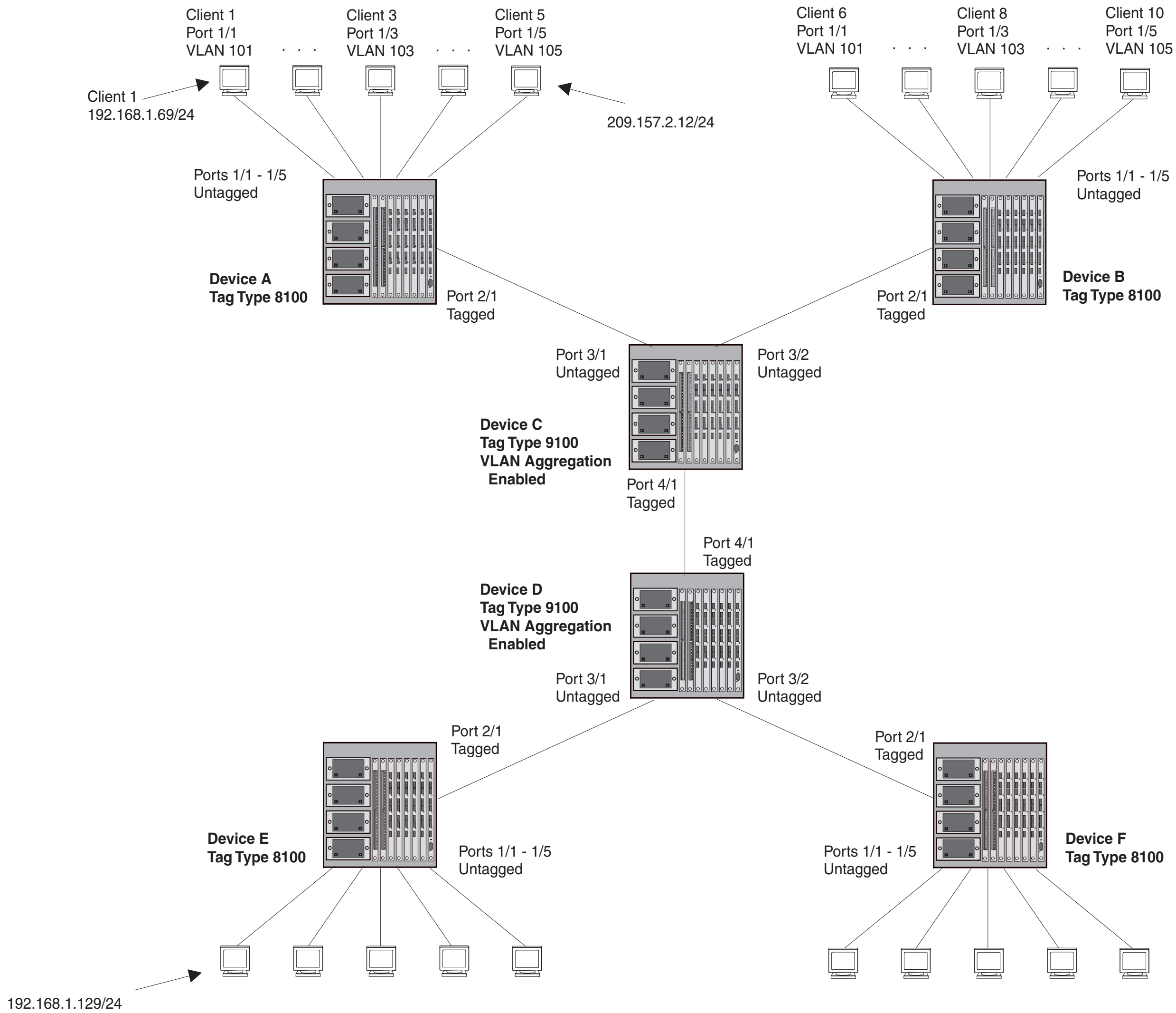


Figure 16.17 Example Super Aggregated VLAN Application

In this example, a collocation service provides private channels for multiple clients. Although the same devices are used for all the clients, the VLANs ensure that each client receives its own Layer 2 broadcast domain, separate from the broadcast domains of other clients. For example, client 1 cannot ping client 5.

The clients at each end of a channel appear to each other to be directly connected and thus can be on the same sub-net and use network services that require connection to the same sub-net. In this example, client 1 is in sub-net 192.168.1.0/24 and so is the device at the other end of client 1's channel.

Since each VLAN configured on the core devices is an aggregate of multiple client VLANs, the aggregated VLANs greatly increase the number of clients a core device can accommodate.

This example shows a single link between the core devices. However, you can use a trunk group to add link-level redundancy.

Configuring Aggregated VLANs

To configure aggregated VLANs, perform the following tasks:

- On each edge device, configure a separate port-based VLAN for each client connected to the edge device. In each client VLAN:

- Add the port connected to the client as an untagged port.
- Add the port connected to the core device (the device that will aggregate the VLANs) as a tagged port. This port must be tagged because all the client VLANs share the port as an uplink to the core device.

- On each core device:
  - Enable VLAN aggregation. This support allows the core device to add an additional tag to each Ethernet frame that contains a VLAN packet from the edge device. The additional tag identifies the aggregate VLAN (the path). However, the additional tag can cause the frame to be longer than the maximum supported frame size. The larger frame support allows Ethernet frames up to 1530 bytes long.

NOTE: Enable the VLAN aggregation option only on the core devices.

  - Configure a VLAN tag type (tag ID) that is different than the tag type used on the edge devices. If you use the default tag type (8100) on the edge devices, set the tag type on the core devices to another value, such as 9100. The tag type must be the same on all the core devices. The edge devices also must have the same tag type but the type must be different from the tag type on the core devices.

NOTE: You can enable the Spanning Tree Protocol (STP) on the edge devices or the core devices, but not both. If you enable STP on the edge devices and the core devices, STP will prevent client traffic from travelling through the core to the other side.

Configuring Aggregated VLANs on an Edge Device

To configure aggregated VLANs on an edge device, use one of the following methods.

USING THE CLI

To configure the aggregated VLANs on device A in Figure 16.17 on page 16-45, enter the following commands:

```
HP9300(config)# vlan 101 by port
HP9300(config-vlan-101)# tagged ethernet 2/1
HP9300(config-vlan-101)# untagged ethernet 1/1
HP9300(config-vlan-101)# exit
HP9300(config)# vlan 102 by port
HP9300(config-vlan-102)# tagged ethernet 2/1
HP9300(config-vlan-102)# untagged ethernet 1/2
HP9300(config-vlan-102)# exit
HP9300(config)# vlan 103 by port
HP9300(config-vlan-103)# tagged ethernet 2/1
HP9300(config-vlan-103)# untagged ethernet 1/3
HP9300(config-vlan-103)# exit
HP9300(config)# vlan 104 by port
HP9300(config-vlan-104)# tagged ethernet 2/1
HP9300(config-vlan-104)# untagged ethernet 1/4
HP9300(config-vlan-104)# exit
HP9300(config)# vlan 105 by port
HP9300(config-vlan-105)# tagged ethernet 2/1
HP9300(config-vlan-105)# untagged ethernet 1/5
HP9300(config-vlan-105)# exit
HP9300(config)# write memory
```

Syntax: [no] vlan <vlan-id> [by port]

Syntax: [no] tagged ethernet <portnum> [to <portnum> | ethernet <portnum>]

Syntax: [no] untagged ethernet <portnum> [to <portnum> | ethernet <portnum>]

Use the **tagged** command to add the port that the device uses for the uplink to the core device. Use the **untagged** command to add the ports connected to the individual clients.

USING THE WEB MANAGEMENT INTERFACE

You cannot enable VLAN aggregation using the Web management interface. The other options you need for configuring Aggregated VLANs are present in earlier software releases and are supported in the Web management interface. See the "Configuring Virtual LANs" chapter in the September 2000 or later edition of the *Installation and Getting Started Guide*.

Configuring Aggregated VLANs on a Core Device

To configure aggregated VLANs on a core device, use one of the following methods.

USING THE CLI

To configure the aggregated VLANs on device C in Figure 16.17 on page 16-45, enter the following commands:

```
HP9300(config)# tag-type 9100
HP9300(config)# aggregated-vlan
HP9300(config)# vlan 101 by port
HP9300(config-vlan-101)# tagged ethernet 4/1
HP9300(config-vlan-101)# untagged ethernet 3/1
HP9300(config-vlan-101)# exit
HP9300(config)# vlan 102 by port
HP9300(config-vlan-102)# tagged ethernet 4/1
HP9300(config-vlan-102)# untagged ethernet 3/2
HP9300(config-vlan-102)# exit
HP9300(config)# write memory
```

Syntax: [no] tag-type <num>

Syntax: [no] aggregated-vlan

The <num> parameter specifies the tag type can be a hexadecimal value from 0 – ffff. The default is 8100.

USING THE WEB MANAGEMENT INTERFACE

You cannot enable VLAN aggregation using the Web management interface.

Verifying the Configuration

You can verify the VLAN, VLAN aggregation option, and tag configuration by viewing the running-config. To display the running-config, enter the **show running-config** command from any CLI prompt. After you save the configuration changes to the startup-config, you also can display the settings in that file by entering the **show configuration** command from any CLI prompt.

Complete CLI Examples

The following sections show all the Aggregated VLAN configuration commands on the devices in Figure 16.17 on page 16-45.

NOTE: In these examples, the configurations of the edge devices (A, B, E, and F) are identical. The configurations of the core devices (C and D) also are identical. The aggregated VLAN configurations of the edge and core devices on one side must be symmetrical (in fact, a mirror image) to the configurations of the devices on the other side. For simplicity, the example in Figure 16.17 on page 16-45 is symmetrical in terms of the port numbers. This allows the configurations for both sides of the link to be the same. If your configuration does not use symmetrically arranged port numbers, the configurations should not be identical but must use the correct port numbers.

Commands for Device A

```
HP9300A(config)# vlan 101 by port
HP9300A(config-vlan-101)# tagged ethernet 2/1
HP9300A(config-vlan-101)# untagged ethernet 1/1
HP9300A(config-vlan-101)# exit
HP9300A(config)# vlan 102 by port
HP9300A(config-vlan-102)# tagged ethernet 2/1
```

```
HP9300A(config-vlan-102)# untagged ethernet 1/2
HP9300A(config-vlan-102)# exit
HP9300A(config)# vlan 103 by port
HP9300A(config-vlan-103)# tagged ethernet 2/1
HP9300A(config-vlan-103)# untagged ethernet 1/3
HP9300A(config-vlan-103)# exit
HP9300A(config)# vlan 104 by port
HP9300A(config-vlan-104)# tagged ethernet 2/1
HP9300A(config-vlan-104)# untagged ethernet 1/4
HP9300A(config-vlan-104)# exit
HP9300A(config)# vlan 105 by port
HP9300A(config-vlan-105)# tagged ethernet 2/1
HP9300A(config-vlan-105)# untagged ethernet 1/5
HP9300A(config-vlan-105)# exit
HP9300A(config)# write memory
```

Commands for Device B

The commands for configuring device B are identical to the commands for configuring device A. Notice that you can use the same channel VLAN numbers on each device. The devices that aggregate the VLANs into a path can distinguish between the identically named channel VLANs based on the ID of the path VLAN.

```
HP9300B(config)# vlan 101 by port
HP9300B(config-vlan-101)# tagged ethernet 2/1
HP9300B(config-vlan-101)# untagged ethernet 1/1
HP9300B(config-vlan-101)# exit
HP9300B(config)# vlan 102 by port
HP9300B(config-vlan-102)# tagged ethernet 2/1
HP9300B(config-vlan-102)# untagged ethernet 1/2
HP9300B(config-vlan-102)# exit
HP9300B(config)# vlan 103 by port
HP9300B(config-vlan-103)# tagged ethernet 2/1
HP9300B(config-vlan-103)# untagged ethernet 1/3
HP9300B(config-vlan-103)# exit
HP9300B(config)# vlan 104 by port
HP9300B(config-vlan-104)# tagged ethernet 2/1
HP9300B(config-vlan-104)# untagged ethernet 1/4
HP9300B(config-vlan-104)# exit
HP9300B(config)# vlan 105 by port
HP9300B(config-vlan-105)# tagged ethernet 2/1
HP9300B(config-vlan-105)# untagged ethernet 1/5
HP9300B(config-vlan-105)# exit
HP9300B(config)# write memory
```

Commands for Device C

Since device C is aggregating channel VLANs from devices A and B into a single path, you need to change the tag type and enable VLAN aggregation.

```
HP9300C(config)# tag-type 9100
HP9300C(config)# aggregated-vlan
HP9300C(config)# vlan 101 by port
HP9300C(config-vlan-101)# tagged ethernet 4/1
HP9300C(config-vlan-101)# untagged ethernet 3/1
HP9300C(config-vlan-101)# exit
HP9300C(config)# vlan 102 by port
HP9300C(config-vlan-102)# tagged ethernet 4/1
HP9300C(config-vlan-102)# untagged ethernet 3/2
HP9300C(config-vlan-102)# exit
HP9300C(config)# write memory
```

Commands for Device D

Device D is at the other end of path and separates the channels back into individual VLANs. The tag type must be the same as tag type configured on the other core device (Device C). In addition, VLAN aggregation also must be enabled.

```
HP9300D(config)# tag-type 9100
HP9300D(config)# aggregated-vlan
HP9300D(config)# vlan 101 by port
HP9300D(config-vlan-101)# tagged ethernet 4/1
HP9300D(config-vlan-101)# untagged ethernet 3/1
HP9300D(config-vlan-101)# exit
HP9300D(config)# vlan 102 by port
HP9300D(config-vlan-102)# tagged ethernet 4/1
HP9300D(config-vlan-102)# untagged ethernet 3/2
HP9300D(config-vlan-102)# exit
HP9300D(config)# write memory
```

Commands for Device E

Since the configuration in Figure 16.17 on page 16-45 is symmetrical, the commands for configuring device E are identical to the commands for configuring device A.

```
HP9300E(config)# vlan 101 by port
HP9300E(config-vlan-101)# tagged ethernet 2/1
HP9300E(config-vlan-101)# untagged ethernet 1/1
HP9300E(config-vlan-101)# exit
HP9300E(config)# vlan 102 by port
HP9300E(config-vlan-102)# tagged ethernet 2/1
HP9300E(config-vlan-102)# untagged ethernet 1/2
HP9300E(config-vlan-102)# exit
HP9300E(config)# vlan 103 by port
HP9300E(config-vlan-103)# tagged ethernet 2/1
HP9300E(config-vlan-103)# untagged ethernet 1/3
HP9300E(config-vlan-103)# exit
HP9300E(config)# vlan 104 by port
HP9300E(config-vlan-104)# tagged ethernet 2/1
HP9300E(config-vlan-104)# untagged ethernet 1/4
HP9300E(config-vlan-104)# exit
HP9300E(config)# vlan 105 by port
HP9300E(config-vlan-105)# tagged ethernet 2/1
HP9300E(config-vlan-105)# untagged ethernet 1/5
HP9300E(config-vlan-105)# exit
HP9300E(config)# write memory
```

Commands for Device F

The commands for configuring device F are identical to the commands for configuring device E. In this example, since the port numbers on each side of the configuration in Figure 16.17 on page 16-45 are symmetrical, the configuration of device F is also identical to the configuration of device A and device B.

```
HP9300F(config)# vlan 101 by port
HP9300F(config-vlan-101)# tagged ethernet 2/1
HP9300F(config-vlan-101)# untagged ethernet 1/1
HP9300F(config-vlan-101)# exit
HP9300F(config)# vlan 102 by port
HP9300F(config-vlan-102)# tagged ethernet 2/1
HP9300F(config-vlan-102)# untagged ethernet 1/2
HP9300F(config-vlan-102)# exit
HP9300F(config)# vlan 103 by port
HP9300F(config-vlan-103)# tagged ethernet 2/1
HP9300F(config-vlan-103)# untagged ethernet 1/3
```

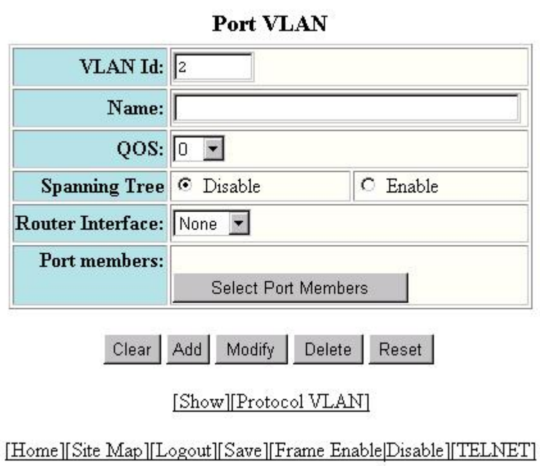
```
HP9300F(config-vlan-103)# exit
HP9300F(config)# vlan 104 by port
HP9300F(config-vlan-104)# tagged ethernet 2/1
HP9300F(config-vlan-104)# untagged ethernet 1/4
HP9300F(config-vlan-104)# exit
HP9300F(config)# vlan 105 by port
HP9300F(config-vlan-105)# tagged ethernet 2/1
HP9300F(config-vlan-105)# untagged ethernet 1/5
HP9300F(config-vlan-105)# exit
HP9300F(config)# write memory
```

Configuring VLANs Using the Web Management Interface

Use the procedures in the following sections to configure VLANs using the Web management interface.

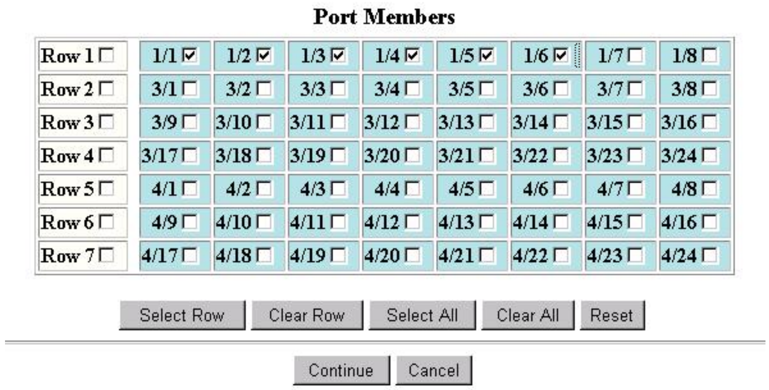
Configuring a Port-Based VLAN

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled OSPF, enable it by clicking on the Enable radio button next to OSPF on the System configuration dialog, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to VLAN in the tree view to expand the list of VLAN option links.
5. Click on the Port link.
   - If the device does not have any port-based VLANs, the Port VLAN configuration panel is displayed, as shown in the following example.
   - If at least one port-based VLAN is already configured and you are adding a new one, click on the Add Port VLAN link to display the Port VLAN configuration panel, as shown in the following example.
   - If you are modifying an existing port-based VLAN, click on the Modify button to the right of the row describing the VLAN to display the Port VLAN configuration panel, as shown in the following example.



6. Enter the VLAN ID and optionally the name.
7. If you want to assign the VLAN to a different Quality of Service (QoS) priority, select the priority from the QoS field's pulldown menu. For more information, see "Changing a Layer 2 Port-Based VLAN's Priority" on page 2-12.
8. Select Enable to Disable next to Spanning Tree to enable or disable the feature on this VLAN.
9. Select the virtual interface (router interface) if applicable.

10. Click the Select Port Members button to display the following panel.



11. Select the ports you are placing in the VLAN. To select a row, click on the checkbox next to the row number, then click on the Select Row button.

NOTE: Ports highlighted in grey are members of a trunk group. The port right before the grey ports is the master port for that trunk group.

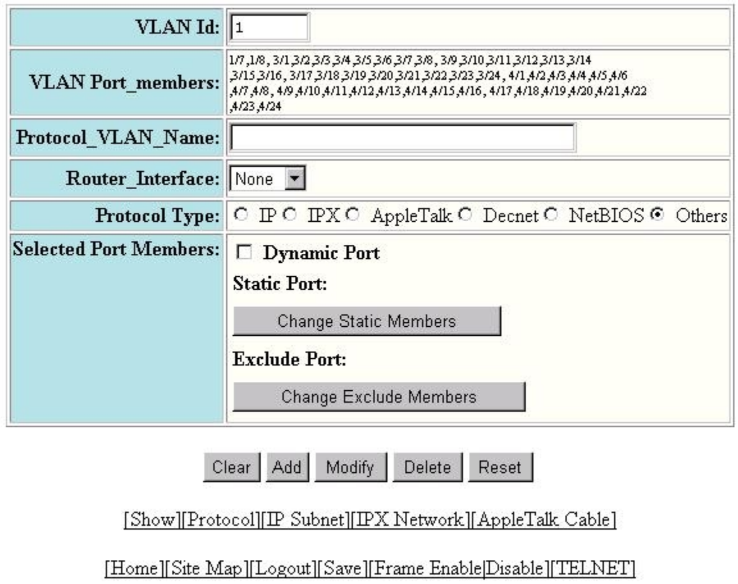
12. When you finish selecting the ports, click on the Continue button to return to the Port VLAN configuration dialog.
13. Click the Add button (to add a new VLAN) or the Modify button (if you are modifying an existing VLAN) to save the change to the device's running-config file.
14. Select the Save link at the bottom of the dialog, then select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

NOTE: You also can access the dialog for saving configuration changes by clicking on Command in the tree view, then clicking on Save to Flash.

Configuring a Protocol-Based VLAN

This procedure describes how to configure a protocol-based VLAN. To configure an IP sub-net VLAN, IPX network VLAN, or AppleTalk cable VLAN, se the sections following this one.

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to VLAN in the tree view to expand the list of VLAN option links.
4. Click on the Protocol link.
   - If the device does not have any protocol VLANs, the Protocol VLAN configuration panel is displayed, as shown in the following example.
   - If at least one protocol VLAN is already configured and you are adding a new one, click on the Protocol link to display the Protocol VLAN configuration panel.
   - If you are modifying an existing protocol VLAN, click on the Modify button to the right of the row describing the VLAN to display the configuration panel for the type of VLAN you are modifying. The following example shows the Protocol VLAN configuration dialog, used for configuring a protocol VLAN (not an IP sub-net, IPX network, or AppleTalk cable VLAN).



5. Enter the VLAN ID that will contain the protocol VLAN in the VLAN ID field.
6. Enter a name for the VLAN in the Protocol_VLAN_Name field.
7. Select the virtual interface from the Router_Interface pulldown list if you configured a virtual interface for routing into and out of the VLAN.
8. Select the protocol type.
9. Specify the port that are members for the VLAN:
    - Select Dynamic Port if you want the port membership to be dynamic. For information, see “Dynamic Ports” on page 16-9.
    - Click the Change Static Members button if you want to configure static ports. For information, see “Static Ports” on page 16-10.
    - Click the Change Exclude Members button if you want to explicitly exclude some ports. For information, see “Excluded Ports” on page 16-10.

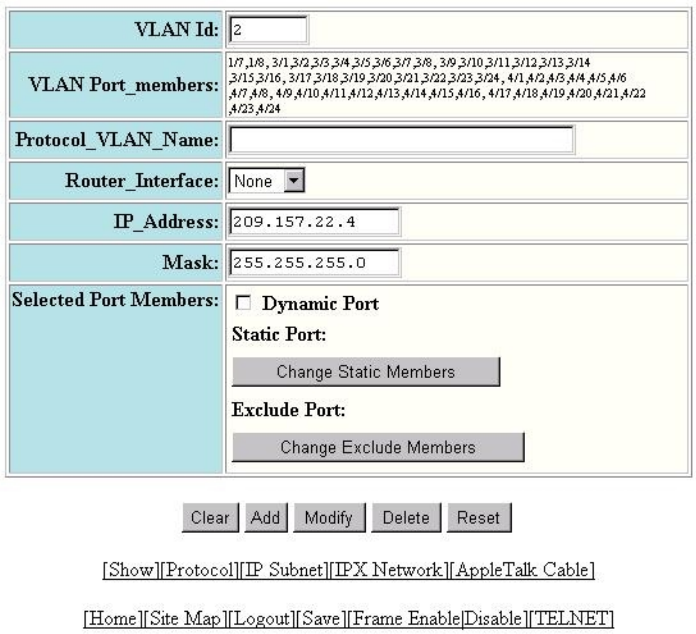
NOTE: All the ports must be members of the port-based VLAN that contains this IP sub-net VLAN. See “Layer 3 Protocol-Based VLANs” on page 16-3.

10. Click the Add button (if you are adding a new VLAN) or the Modify button (if you are modifying an existing VLAN) to save the change to the device’s running-config file.
11. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

NOTE: You also can access the dialog for saving configuration changes by clicking on Command in the tree view, then clicking on Save to Flash.

Configuring an IP Sub-Net VLAN

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to VLAN in the tree view to expand the list of VLAN option links.
4. Click on the Protocol link.
   - If the device does not have any protocol VLANs, the Protocol VLAN configuration panel is displayed, as shown in the following example.
   - If at least one protocol VLAN is already configured and you are adding a new one, click on the IP Subnet link to display the IP Sub-net Protocol VLAN configuration panel.
   - If you are modifying an existing protocol VLAN, click on the Modify button to the right of the row describing the VLAN to display the configuration panel for the type of VLAN you are modifying. The following example shows the IP Sub-net Protocol VLAN configuration dialog, used for configuring an IP sub-net protocol VLAN (not a protocol, IPX network, or AppleTalk cable VLAN)



5. Enter the VLAN ID that will contain the IP sub-net VLAN in the VLAN ID field.
6. Enter a name for the VLAN in the Protocol_VLAN_Name field.
7. Select the virtual interface from the Router_Interface pulldown list if you configured a virtual interface for routing into and out of the VLAN.
8. Enter the IP address of the VLAN in the IP_Address field.
9. Enter the network mask in the Mask field.
10. Specify the port that are members for the VLAN:
    - Select Dynamic Port if you want the port membership to be dynamic. For information, see "Dynamic Ports" on page 16-9.
    - Click the Change Static Members button if you want to configure static ports. For information, see "Static Ports" on page 16-10.
    - Click the Change Exclude Members button if you want to explicitly exclude some ports. For information, see "Excluded Ports" on page 16-10.

NOTE: All the ports must be members of the port-based VLAN that contains this IP sub-net VLAN. See “Layer 3 Protocol-Based VLANs” on page 16-3.

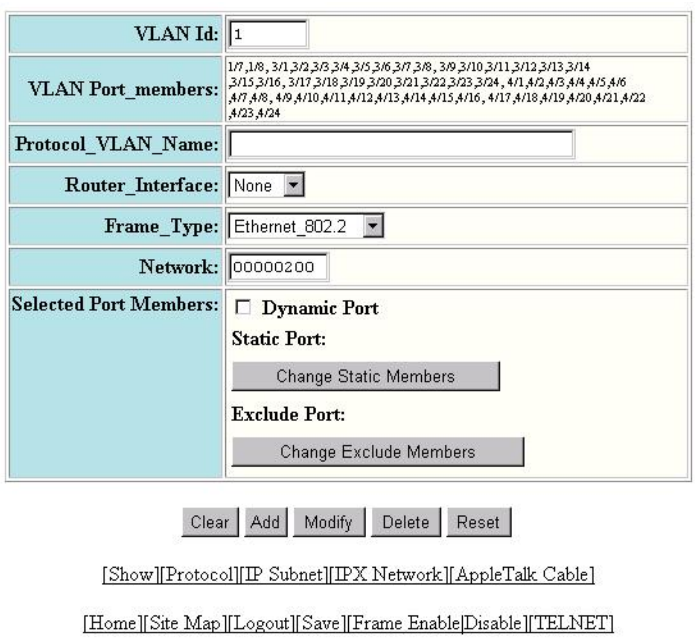
---

11. Click the Add button (if you are adding a new VLAN) or the Modify button (if you are modifying an existing VLAN) to save the change to the device’s running-config file.
12. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

NOTE: You also can access the dialog for saving configuration changes by clicking on Command in the tree view, then clicking on Save to Flash.

Configuring an IPX Network VLAN

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to VLAN in the tree view to expand the list of VLAN option links.
4. Click on the Protocol link.
   - If the device does not have any protocol VLANs, the Protocol VLAN configuration panel is displayed, as shown in the following example.
   - If at least one protocol VLAN is already configured and you are adding a new one, click on the IPX Network link to display the IP Sub-net Protocol VLAN configuration panel.
   - If you are modifying an existing protocol VLAN, click on the Modify button to the right of the row describing the VLAN to display the configuration panel for the type of VLAN you are modifying. The following example shows the IPX Network Protocol VLAN configuration dialog, used for configuring an IPX network protocol VLAN (not a protocol, IP sub-net, or AppleTalk cable VLAN)



5. Enter the VLAN ID that will contain the IPX network VLAN in the VLAN ID field.
6. Enter a name for the VLAN in the Protocol_VLAN_Name field.

7. Select the virtual interface from the Router_Interface pulldown list if you configured a virtual interface for routing into and out of the VLAN.
8. Select the encapsulation type from the Frame_Type field's pulldown list.
9. Enter the IPX network address of the VLAN in the Network field.
10. Specify the port that are members for the VLAN:
    - Select Dynamic Port if you want the port membership to be dynamic. For information, see "Dynamic Ports" on page 16-9.
    - Click the Change Static Members button if you want to configure static ports. For information, see "Static Ports" on page 16-10.
    - Click the Change Exclude Members button if you want to explicitly exclude some ports. For information, see "Excluded Ports" on page 16-10.

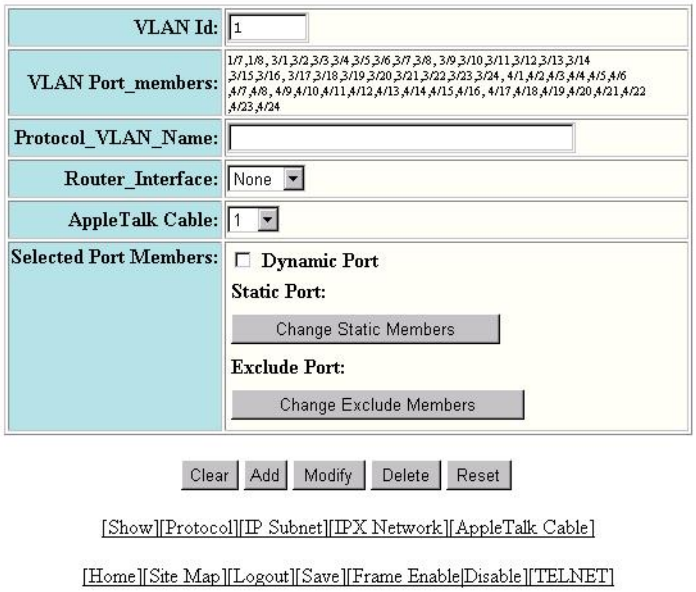
NOTE: All the ports must be members of the port-based VLAN that contains this IPX network VLAN. See "Layer 3 Protocol-Based VLANs" on page 16-3.

11. Click the Add button (if you are adding a new VLAN) or the Modify button (if you are modifying an existing VLAN) to save the change to the device's running-config file.
12. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

NOTE: You also can access the dialog for saving configuration changes by clicking on Command in the tree view, then clicking on Save to Flash.

Configuring an AppleTalk Cable VLAN

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to VLAN in the tree view to expand the list of VLAN option links.
4. Click on the Protocol link.
    - If the device does not have any protocol VLANs, the Protocol VLAN configuration panel is displayed, as shown in the following example.
    - If at least one protocol VLAN is already configured and you are adding a new one, click on the AppleTalk Cable link to display the AppleTalk Cable VLAN configuration panel.
    - If you are modifying an existing protocol VLAN, click on the Modify button to the right of the row describing the VLAN to display the configuration panel for the type of VLAN you are modifying. The following example shows the AppleTalk Cable VLAN configuration dialog, used for configuring an AppleTalk cable VLAN (not a protocol, IP sub-net, or IPX network VLAN).



5. Enter the VLAN ID that will contain the AppleTalk cable VLAN in the VLAN ID field.
6. Enter a name for the VLAN in the Protocol_VLAN_Name field.
7. Select the virtual interface from the Router_Interface pulldown list if you configured a virtual interface for routing into and out of the VLAN.
8. Select the AppleTalk cable ID from the AppleTalk Cable field's pulldown list.
9. Specify the port that are members for the VLAN:
   - Select Dynamic Port if you want the port membership to be dynamic. For information, see "Dynamic Ports" on page 16-9.
   - Click the Change Static Members button if you want to configure static ports. For information, see "Static Ports" on page 16-10.
   - Click the Change Exclude Members button if you want to explicitly exclude some ports. For information, see "Excluded Ports" on page 16-10.

NOTE: All the ports must be members of the port-based VLAN that contains this AppleTalk cable VLAN. See "Layer 3 Protocol-Based VLANs" on page 16-3.

10. Click the Add button (if you are adding a new VLAN) or the Modify button (if you are modifying an existing VLAN) to save the change to the device's running-config file.
11. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

NOTE: You also can access the dialog for saving configuration changes by clicking on Command in the tree view, then clicking on Save to Flash.

Displaying VLAN Information

After you configure the VLANs, you can verify the configuration using the following methods.

Displaying System-Wide VLAN Information

Use one of the following methods to display VLAN information for all the VLANs configured on the device.

USING THE CLI

Enter the following command at any CLI level. This example shows the display for the IP sub-net and IPX network VLANs configured in the examples in "Configuring an IP Sub-Net VLAN with Dynamic Ports" on page 16-33 and "Configuring an IPX Network VLAN with Dynamic Ports" on page 16-34.

```
HP9300(config)# show vlans

Total PORT-VLAN entries: 2
Maximum PORT-VLAN entries: 8
legend: [S=Slot]

PORT-VLAN 1, Name DEFAULT-VLAN, Priority level0, Spanning tree Off
 Untagged Ports: (S2)  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16
 Untagged Ports: (S2) 17 18 19 20 21 22 23 24
 Untagged Ports: (S4)  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16
 Untagged Ports: (S4) 17 18 19 20 21 22 23 24
   Tagged Ports: None

PORT-VLAN 10, Name IP_VLAN, Priority level0, Spanning tree Off
 Untagged Ports: (S1)  1  2  3  4  5  6
   Tagged Ports: None

 IP-subnet VLAN 1.1.1.0 255.255.255.0, Dynamic port enabled
          Name: Mktg-LAN
  Static ports: None
 Exclude ports: None
 Dynamic ports: (S1)  1  2  3  4  5  6
 PORT-VLAN 20, Name IPX_VLAN, Priority level0, Spanning tree Off
 Untagged Ports: (S2)  1  2  3  4  5  6
   Tagged Ports: None

 IPX-network VLAN 0000ABCD, frame type ethernet_ii, Dynamic port enabled
          Name: Eng-LAN
  Static ports: None
 Exclude ports: None
 Dynamic ports: (S2)  1  2  3  4  5  6
```

Syntax: show vlans [<vlan-id> | ethernet <portnum>]

USING THE WEB MANAGEMENT INTERFACE

To display VLAN configuration information:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to VLAN in the tree view to expand the list of VLAN option links.
4. Click on the Port link to display the Port-based VLAN table or the Protocol link to display the Protocol-based VLAN table.

Displaying VLAN Information for Specific Ports

Use one of the following methods to display VLAN information for specific ports.

USING THE CLI

To display VLAN information for all the VLANs of which port 7/1 is a member, enter the following command:

```
HP9300(config)# show vlans e 7/1

Total PORT-VLAN entries: 3
Maximum PORT-VLAN entries: 8

legend: [S=Slot]

PORT-VLAN 100, Name [None], Priority level0, Spanning tree Off
 Untagged Ports: (S7)  1  2  3  4
   Tagged Ports: None

 IP-subnet VLAN 207.95.11.0 255.255.255.0, Dynamic port disabled
 Static ports: (S7)  1  2
 Exclude ports: None
 Dynamic ports: None
```

Syntax: show vlans [<vlan-id> | ethernet <portnum>]

The <vlan-id> parameter specifies a VLAN for which you want to display the configuration information.

The **ethernet** <portnum> parameter specifies a port.

USING THE WEB MANAGEMENT INTERFACE

You cannot display port-specific VLAN information using the Web management interface.

Chapter 17
Route Health Injection

You can configure an HP 9304M, HP 9308M, and HP 6308M-SX routing switch to check the health of the HTTP application and "inject" a host route into the network to force a preferred route to an actively responding web host. The web host can be directly attached to the routing switch or can be attached through Layer 2 switches. The web host can be a web server or a Server Load Balancing (SLB) device configured with a virtual IP address (VIP) representing the HTTP application.

The ***route health injection*** feature enables a routing switch to advertise a host route to a globally-distributed web site. Gateway routers that receive the host route along with other routes to the same web site in other locations can choose the best route. Web clients attached to the gateway servers thus enjoy fast response time regardless of their location, because their gateway routers use the best path to the web site. By advertising the host route instead of a network route to the web site's IP address, the routing switch ensures that gateway routers receive a route to the IP address only if that IP address is available. The routing switch uses a Layer-4 HTTP health check that you configure to determine whether the HTTP (web) service on the IP address is available. The health check and how to configure it are described later in this section.

NOTE: This feature supports health checks only for TCP port 80 (HTTP).

Normally, an IP address should exist on only one host on the public Internet. However, some third-party SLBs allow the same IP address to exist on multiple machines using virtual IP addresses (VIPs). A VIP is an IP address that you configure on a third-party SLB, then associate with "real" servers attached to the SLB. These real servers are the web hosts that contain the web site requested by clients. In a simple SLB configuration, a single SLB contains a VIP that maps to multiple real servers that have identical contents. The VIP is the IP address associated with the web site on DNS servers. In a globally-distributed SLB configuration, multiple SLBs in different networks throughout the Internet are configured with same VIP and are attached to sets of real servers that contain the web site's content.

Configuration Example

Suppose you configure an SLB in Los Angeles and another one in New York to serve VIP 209.157.22.249. For this example, also assume that you have a real server in Paris with the same IP address and the server is directly attached to a routing switch.

Suppose the DNS entry for this IP address maps the address to a site named www.acmeweb.com. When a web client in Los Angeles enters this domain in their web browser, the web browser goes to the client's local DNS to resolve the name into an IP address. When the DNS returns the address to the web browser, the browser then attempts to contact the HTTP port (usually TCP port 80) on the host with the IP address returned by the DNS.

Figure 17.1 shows an example of a globally-distributed SLB configuration in which the route health injection feature is used.

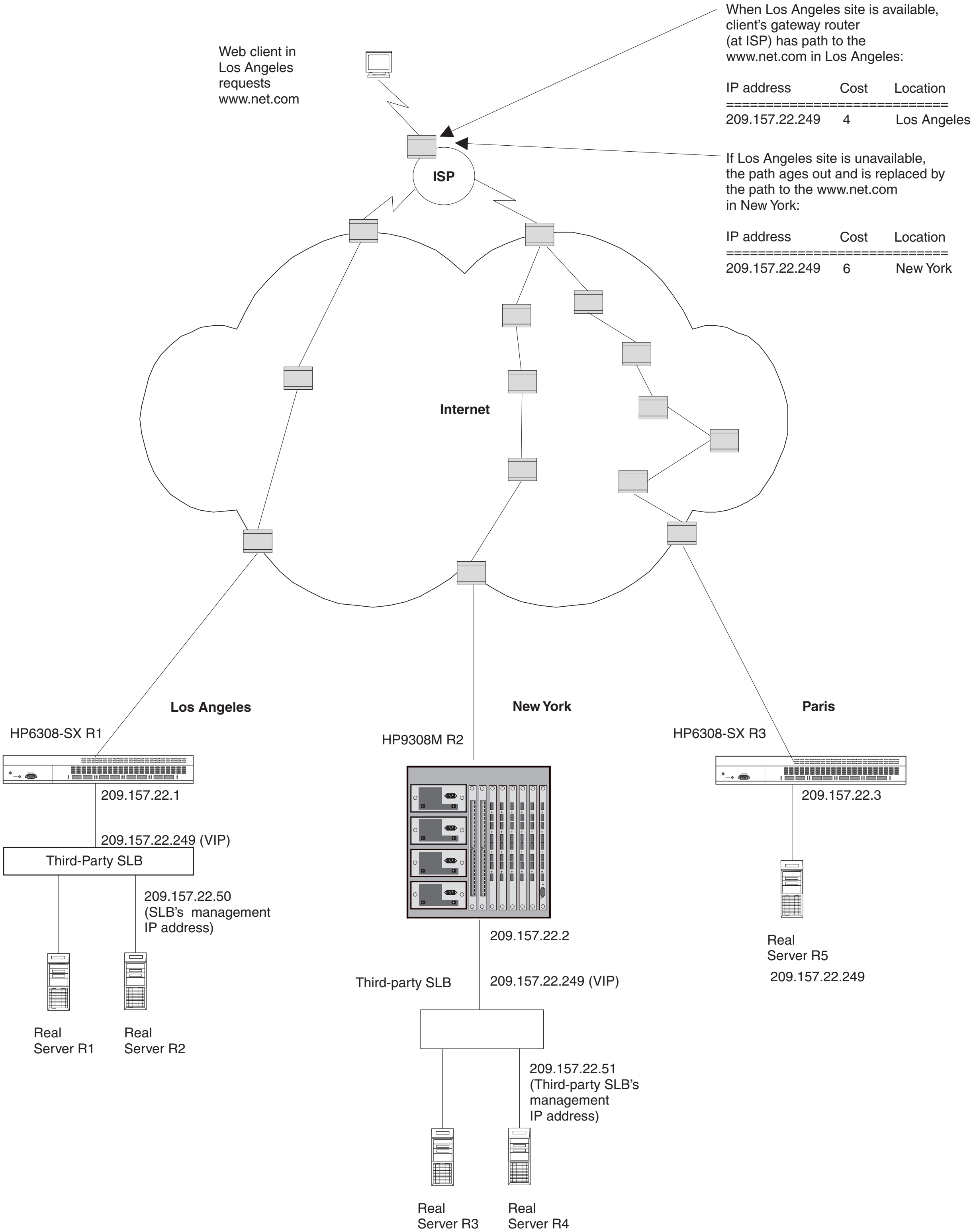


Figure 17.1 Route health injection configuration

When the web browser sends its TCP SYN request (to initiate the HTTP session with the web host), the gateway router used by the client's computer looks in its routing table for the route to the requested IP address. The router may receive multiple paths, in which case the router typically chooses the path with the lowest cost (usually the number of router hops to the host) to place in the routing table. The paths can all go to the same host or to different hosts. In the case of globally-distributed SLB, the paths go to different hosts. The shortest path takes the client to the gateway router attached to the SLB or the directly-attached server that is closest to the client. Thus, when a client on the West coast requests the web site, the client's gateway sends the request to the SLB in Los Angeles. A client in London would instead be directed to the directly-attached server in Paris.

The router's behavior works well when all the real servers are available. However, suppose the real servers attached to the SLB in Los Angeles become unavailable. This results in the VIP on that SLB becoming unavailable.

In a globally-distributed SLB configuration, a client can still reach the desired VIP (web site) if the client's gateway router receives a path to another site that contains the VIP the client is trying to reach. However, gateway routers typically advertise network routes rather than host routes. As a result, even if the VIP (web site) is unavailable, the gateway router still advertises the network to which the VIP belongs. Consequently, a client's gateway router can still have a path to the unavailable server, in which case the client does not receive the requested web page.

By configuring the routing switches attached to the SLBs or real servers that contain the web site to check the health of the web site (HTTP application), you can ensure that the routing switches advertise paths only to for web site locations that are available:

- If the web site passes the health check, the routing switch advertises a host route to the web site's IP address.
- If the web site fails the health check, the routing switch removes the host route. The route is no longer advertised and ages out of the routing tables in clients' gateway routers.

As a result, those paths to the web site's IP address that are no longer available age out of the routing tables on gateway routers while the paths that are still available remain in the routing tables. When a client uses its gateway router to reach the web site, the gateway's path to the site's IP address is usually the one with the lowest cost. In Figure 17.1, when the site at Los Angeles is available, the client's gateway uses the path to Los Angeles as the route to IP address 209.157.22.249. However, if the IP address at the Los Angeles site becomes unavailable and thus fails its health check, the HP 6308M-SX routing switch at the Los Angeles site removes the static host route for 209.157.22.249 from its route table. The path on the client's gateway ages out and is replaced by the next valid path with the lowest cost, in this case the path to 209.157.22.249 at the New York site.

HTTP Health Check Algorithm

When you configure a routing switch to periodically check the health of the HTTP port on a web server, the routing switch does one of the following based on the result of the health check. The health check algorithm applies regardless of whether the web server is directly attached to the routing switch (or attached through Layer 2 switches) or is attached to an SLB that is load balancing the IP address among multiple servers.

- If the health check is successful, the routing switch places a static host route in its route table for the web site's IP address. When the routing switch sends a routing advertisement, the host route is included. The client's gateway router will receive this host route as one of the paths to the IP address.
- If the health check is not successful, the routing switch removes the static host route (if present) for the IP address. As a result, the route ages out of the routing tables on other routers. After the removed route ages out of the routing table on the client's gateway router, the router accepts another path to the IP address.

You can configure a separate HTTP health check for each web site IP address. The health check consists of a standard TCP connection followed by a standard request for an HTTP page on the IP address. If the HTTP page responds with an acceptable HTTP status code, the IP address passes the health check, at which point the routing switch leaves the static host route to the IP address in the route table or adds the route if it is not present.

By default, the HTTP health check is disabled. Once you enable the health check, the routing switch sends the health check every five seconds by default. The default health check consists of a HEAD request for the default home page "1.0". If the web site does not respond to a health check, the routing switch resends the health check up to two more times by default before determining that the web site is no longer available and removing the static host route for the web site.

All the health check parameters are configurable. See "CLI Syntax" on page 17-4.

Configuration Considerations

- The routing switch and the SLB or real server must be in the same IP sub-net.
- Place the management station for the SLB on a different sub-net than the one that contains the web site (HTTP application) whose health you are checking. If the web site and the management station are on the same sub-net, the **ip dont_advertise** command (see "CLI Syntax" on page 17-4) will prevent you from reaching the SLB through the management station.
- You cannot use the same routing switch port for OSPF and for the health check. If the port already contains configuration information for one of these features, you cannot configure the other feature unless you first remove the configuration information for the first feature.

CLI Syntax

Use the following commands to configure the health check parameters on a routing switch.

Global CONFIG Level

Use the following command at the global CONFIG level to identify the VIP that has the HTTP port the routing switch is checking.

Syntax: server real <name> <vip>

The <name> parameter identifies the SLB or real server. This value does not need to match a value on the SLB or real server. The value simply identifies the SLB or real server uniquely on the routing switch.

The <vip> parameter is the IP address of the web site. If the web server is directly attached to the routing switch, this is the IP address of the web server. If the web server is attached to an SLB, the VIP is the virtual IP address configured on the SLB for the web site.

Use the following commands to change the interval and retry values for the HTTP health check. When you press Enter after the first command, the CLI changes to the TPC/UDP port configuration level for port 80.

Syntax: server port 80

Syntax: tcp keepalive <interval> <retries>

The <interval> parameter specifies the number of seconds between health checks sent by the routing switch. You can specify a number from 2 – 60 seconds. The default is 5 seconds.

The <retries> parameter specifies how many times the routing switch will resend a health check if the web site does not respond. You can specify from 1 – 5 retries. The default is 2.

Real Server Level

After you enter the **server real…** command shown above, the CLI changes to the Real Server level.

The following command enables the HTTP health check for the web site. The health check is disabled by default.

Syntax: port http keepalive

The following command is optional and changes the default method and URL for the health check. By default, the routing switch sends a HEAD request for the default homepage, "1.0". The slash in the URL is optional; the routing switch inserts the slash for you if you leave it out.

Syntax: port http url "[GET | HEAD] [/]<URL-page-name>"

The following command changes the HTTP status codes that the routing switch accepts as valid responses to a health check. The default status code range for HTTP health checks in SLB configurations is 200 – 299. You can specify up to four discrete ranges. To specify a single message code for a range, enter the code twice. For example to specify 200 only, enter the following command: **port http status_code 200 200**.

Syntax: port http status_code <range> [<range> [<range> [<range>]]]

Interface Level

The following commands configure an IP sub-net address that is in the same sub-net as the web site's IP address. Enter these commands on the interface that connects the routing switch to the real server or to the SLB that is load balancing for the IP address.

The **ip dont_advertise** command configures the routing switch to block advertisement of the host route for the interface. If you do not block the network route, the routing switch will still advertise a network route to the network containing the web site even if the web site itself is unavailable. After you enter the **ip dont_advertise** command, the routing switch advertises only a host route to the IP address. Thus, if the web site fails the HTTP health check, the routing switch removes the static host route for the web site's IP address and also does not advertise a network route for the network containing the IP address.

Syntax: ip address <ip-addr> <ip-mask> [secondary]

Or

Syntax: ip address <ip-addr>/<mask-bits>

Syntax: ip dont_advertise <ip-addr> <ip-mask>

Or

Syntax: ip dont_advertise <ip-addr>/<mask-bits>

Configuring the HTTP Health Check on the Routing Switch

To configure a routing switch to perform the HTTP health check for a web site and to manage a static host route for the IP address, do the following:

- Identify the web site's IP address on the routing switch.
- Enable the HTTP keepalive (health check).
- Optionally modify the health-check keepalive interval and retries.
- Optionally modify site-specific health check parameters (the URL requested by the health check and the HTTP status codes that the routing switch will accept as a normal response).
- Configure the port that connects the routing switch to the HTTP application (SLB or real server) to not advertise the network route for the IP sub-net the SLB or real server and the port are on.

For example, to configure routing switches for the configuration shown in Figure 17.1, enter the following CLI commands.

CLI Commands for 6308M-SX R1

To configure the health check on 6308M-SX R1, enter the following commands:

```
HP6308-R1(config) server real S1 209.157.22.249

HP6308-R1(config-rs-S1) port http keepalive

HP6308-R1(config-rs-S1) interface ethernet 6

HP6308-R1(config-if-6) ip address 209.157.22.1/24

HP6308-R1(config-if-6) ip dont_advertise 209.157.22.1/24

HP6308-R1(config-if-6) write memory
```

Syntax: server real <name> <ip-addr>

Syntax: port http keepalive

Syntax: ip dont_advertise <ip-addr> <ip-mask>

Or

Syntax: ip dont_advertise <ip-addr>/<mask-bits>

The **server real** command in this example configures the HP 6308M-SX to send an HTTP health check to the HTTP port on IP address 209.157.22.249. When you press Enter after this command, the CLI changes to the Real Server level of the CLI. This level allows you to configure health check parameters for the HTTP port on the IP address.

The **port http keepalive** command in this example is entered at the Real Server level and enables the HTTP health check. The health check is disabled by default, so you must enter this command. You can enter additional commands at this level to modify the health check parameters. These commands are shown in the examples for 9308M R2 and 6308M-SX R3.

The **ip address** command adds an IP interface for the connection to the IP address. This interface must be in the same sub-net as the IP address.

The **ip dont_advertise** command configures the routing switch to block advertisement of the network route for this IP sub-net address. This command ensures that the routing switch advertises only the host route to the IP address. If the routing switch advertises the network route to the sub-net containing the IP address, then even if the routing switch removes the host route from its routing table, the routing switch will still advertise the network route to the IP address (and thus to the web server), defeating the failover capability of globally-distributed SLB.

CLI Commands for 9308M R2

The following commands configure 9308M R2 for the configuration shown in Figure 2.

```
HP9300-R2(config) server real S2 209.157.22.249
HP9300-R2(config-rs-S2) port http keepalive
HP9300-R2(config-rs-S2) port http url "/sales.html"
HP9300-R2(config-rs-S2) port http status_code 200 199
HP9300-R2(config-rs-S2) interface ethernet 1/3
HP9300-R2(config-if-1/3) ip address 209.157.22.2/24
HP9300-R2(config-if-1/3) ip dont_advertise 209.157.22.2/24
HP9300-R2(config-if-1/3) write memory
```

Syntax: port http url “[GET | HEAD] [/]<URL-page-name>”

Syntax: port http status_code <range> [<range> [<range> [<range>]]]

The **port http url** command changes the URL that the routing switch sends as part of the health check. By default, the routing switch sends an HTTP HEAD request for the default page (“1.0”). If you enter a URL, the health check instead requests that URL. The slash (/) is an optional parameter. If you do not set the GET or HEAD parameter, and the slash is not in the configured URL page, then the routing switch automatically inserts a slash before retrieving the URL page.

In addition to specifying another URL, you can change the method to GET. Changing the method does not affect the health check from the routing switch‘s standpoint. You can use either method.

The **port http status_code** command in this example changes the range of HTTP status codes the routing switch accepts as normal (healthy) replies to a health check.

CLI Commands for 6308M-SX R3

The following commands configure 6308M-SX R3 for the configuration shown in Figure 17.1. This example includes the commands for modifying the HTTP health check interval and retry values.

```
HP6308-R3(config) server port 80
HP6308-R3(config-port-80) tcp keepalive 10 3
HP6308-R3(config-port-80) server real S3 209.157.22.249
HP6308-R3(config-rs-S2) port http keepalive
HP6308-R3(config-rs-S2) port http url "/marketing.html"
HP6308-R3(config-rs-S2) interface ethernet 9
HP6308-R3(config-if-9) ip address 209.157.22.3/24
HP6308-R3(config-if-9) ip dont_advertise 209.157.22.3/24
HP6308-R3(config-if-9) write memory
```

Syntax: server port 80

Syntax: tcp keepalive <interval> <retries>

The <interval> parameter specifies the number of seconds between health checks sent by the routing switch. You can specify a number from 2 – 60 seconds. The default is 5 seconds.

The <retries> parameter specifies how many times the routing switch will resend a health check if the web site does not respond. You can specify from 1 – 5 retries. The default is 2.

Displaying Server and Application Port Information

You can use the CLI to display the following types of information:

- Server (virtual IP address) information
- Application port information

Displaying Server Information

To display information about the server virtual IP addresses (VIPs) you have configured, enter a command such as the following at any level of the CLI:

```
HP9300-R2# show server real RS2

Real Servers Info

Server State - 1:enabled, 2:failed, 3:test, 4:suspect, 5:grace_dn, 6:active
Name:RS2             IP:  209.157.23.60:4    State:1
```

Syntax: show server real <name>

This display shows the following information.

Table 17.1: Real Server Information

This Field...	Displays...
Server State	The possible values for the server state. The state of each real server is shown by the State field. See below.
Name	The name of the real server. This is the name you assigned to the server when you configured it on the SLB.

Table 17.1: Real Server Information (Continued)

This Field...	Displays...
IP	The IP address of the real server. If you configured a host range of VIPs on the server, the number following the IP address (after the colon) is the number of hosts on the server.
State	The state of the real server. The state can be one of the states listed by “Server State” at the top of the display.

Displaying Keepalive Information

To display the keepalive parameters in effect for the application ports on the servers, enter the following command at any level of the CLI:

Syntax: show server keepalive-port

Appendix A
Network Monitoring

This chapter provides a general overview of monitoring tools supported on HP ProCurve switches and routing switches. Configuration examples are provided using the CLI and Web management interfaces.

RMON Support

All HP ProCurve switches and routing switches come standard with an RMON agent that supports the following groups. The group numbers come from the RMON specification (RFC 1757).

- Statistics (RMON Group 1)
- History (RMON Group 2)
- Alarms (RMON Group 3)
- Events (RMON Group 9)

The CLI allows you to make configuration changes to the control data for these groups, but you need a separate RMON application to view and display the data graphically.

Statistics (RMON Group 1)

Count information on multicast and broadcast packets, total packets sent, undersized and oversized packets, CRC alignment errors, jabbers, collision, fragments and dropped events is collected for each port.

No configuration is required to activate collection of statistics. This activity is by default automatically activated at system start-up.

USING THE CLI

You can view a textual summary of the statistics for all ports by entering the following CLI command:

```
HP9300(config)# show rmon statistics
```

Syntax: show rmon statistics

NOTE: To see RMON statistics for an individual port only, enter the following command noting a specific port entry number: **show rmon statistics** <entry-number>.

USING THE WEB MANAGEMENT INTERFACE

To view the RMON statistics for the system:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.

2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to Port in the tree view to expand the list of Port option links.
4. Click on the Statistics link to display the Port Statistic table.
5. Click on the RMON Ethernet Statistics link to display the RMON Ethernet Statistics table.

NOTE: The number of entries in a RMON statistics table directly corresponds to the number of ports on a system. For example, if the system is an eight-port device, there will be eight entries in the statistics display.

History (RMON Group 2)

All active ports by default will generate two history control data entries per active port. An active port is defined as one with a link up. If the link goes down the two entries are automatically be deleted.

Two history entries are generated for each device:

- a sampling of statistics every 30 seconds
- a sampling of statistics every 30 minutes

The history data can be accessed and displayed using any of the popular RMON applications

USING THE CLI

A sample RMON history command and its syntax is shown below:

```
HP9300(config)# rmon history 1 interface 1 buckets 10 interval 10 owner nyc02
```

Syntax: rmon history <entry-number> interface <portnum> buckets <number> interval <sampling-interval> owner <text-string>

You can modify the sampling interval and the bucket (number of entries saved before overwrite) using the CLI. In the above example, owner refers to the RMON station that will request the information.

NOTE: To review the control data entry for each port or interface, enter the **show rmon history** command.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to Port in the tree view to expand the list of Port option links.
4. Click on the Statistics link to display the Port Statistic table.
5. Click on the History link to display the RMON Ethernet History table.

Alarm (RMON Group 3)

Alarm is designed to monitor configured thresholds for any SNMP integer, time tick, gauge or counter MIB object. Using the CLI, you can define what MIB objects are monitored, the type of thresholds that are monitored (falling, rising or both), the value of those thresholds, and the sample type (absolute or delta).

An alarm event is reported each time that a threshold is exceeded. The alarm entry also indicates the action (event) to be taken if the threshold be exceeded.

USING THE CLI

A sample CLI alarm entry and its syntax is shown below:

```
HP9300(config)# rmon alarm 1 ifInOctets.6 10 delta rising-threshold 100 1 falling
threshold 50 1 owner nyc02
```

Syntax: rmon alarm <entry-number> <MIB-object.interface-num> <sampling-time> <sample-type> <threshold-type> <threshold-value> <event-number> <threshold-type> <threshold-value> <event-number> owner <text-string>

USING THE WEB MANAGEMENT INTERFACE

This display is not supported on the Web management interface.

Event (RMON Group 9)

There are two elements to the Event Group—the ***event control table*** and the ***event log table***.

The event control table defines the action to be taken when an alarm is reported. Defined events can be found by entering the CLI command, show event. The Event Log Table collects and stores reported events for retrieval by an RMON application.

USING THE CLI

A sample entry and syntax of the event control table is shown below:

```
HP9300(config)# rmon event 1 description 'testing a longer string' log-and-trap
public owner nyc02
```

Syntax: rmon event <event-entry> description <text-string> log | trap | log-and-trap owner <rmon-station>

USING THE WEB MANAGEMENT INTERFACE

This display is not supported on the Web management interface.

Viewing System Information

You can access software and hardware information.

USING THE CLI

To view the software and hardware details for the system, enter the **show version** command:

```
HP9300# show version
```

Syntax: show version

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the Device link to display the Device Information panel.

Viewing Configuration Information

You can view a variety of configuration details and statistics with the show option. The **show** option provides a convenient way to check configuration changes before saving them to flash.

The show options available will vary for the HP 6208M-SX and routiing switches and by configuration level.

USING THE CLI

To determine the available show commands for the device or a specific level of the CLI, enter the following command:

```
HP9300# show ?
```

Syntax: show <option>

You also can enter "show" at the command prompt, then press the TAB key.

NOTE: For a complete summary of all available **show...** CLI commands and their displays, see the *Command Line Interface Reference*.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. If needed, click on the plus sign next to a subcategory to display the monitoring links for that category.
4. Click on the link for the information you want to view.

Viewing Port Statistics

Port statistics are polled by default every 10 seconds.

USING THE CLI

You can view statistics for ports by entering the following **show** commands:

- show interfaces
- show configuration

USING THE WEB MANAGEMENT INTERFACE

To view the port statistics for all ports:

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Click on the plus sign next to Port to expand the list of port monitoring options.
4. Select the Statistic link.

Viewing STP Statistics

You can view a summary of STP statistics. STP statistics are by default polled every 10 seconds.

To modify this polling rate (when using the Web management interface), select the Preferences link from the main menu, and modify the STP field. You can disable polling by setting the field to zero.

USING THE CLI

To view spanning tree statistics, enter the **show span** command. To view STP statistics for a VLAN, enter the **span vlan** command.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Monitor in the tree view to expand the list of monitoring options.
3. Select the STP link.

Clearing Statistics

You can clear statistics for many parameters with the clear option.

USING THE CLI

To determine the available **clear** commands for the system, enter the following command:

```
HP9300# clear ?
```

Syntax: clear <option>

You also can enter "clear" at the command prompt, then press the TAB key.

For a complete summary of all available **clear...** CLI commands and their displays, see the *Command Line Interface Reference*.

NOTE: Clear commands are found at the Privileged EXEC level.

USING THE WEB MANAGEMENT INTERFACE

You can clear statistics by doing the following:

1. Log on to the device using a valid user name and password for read-write access. The System configuration dialog is displayed.
2. Click on the plus sign next to Command in the tree view to expand the list of command options.
3. Click on the Clear link to display the Clear panel.
4. Select all items to be cleared.
5. Click Apply.

Appendix B
Protecting Against Denial of Service Attacks

In a Denial of Service (DoS) attack, a router is flooded with useless packets, hindering normal operation. HP devices include measures for defending against two types of DoS attacks: Smurf attacks and TCP SYN attacks.

Protecting Against Smurf Attacks

A ***Smurf attack*** is a kind of DoS attack where an attacker causes a victim to be flooded with ICMP echo (Ping) replies sent from another network. Figure B.1 illustrates how a Smurf attack works.

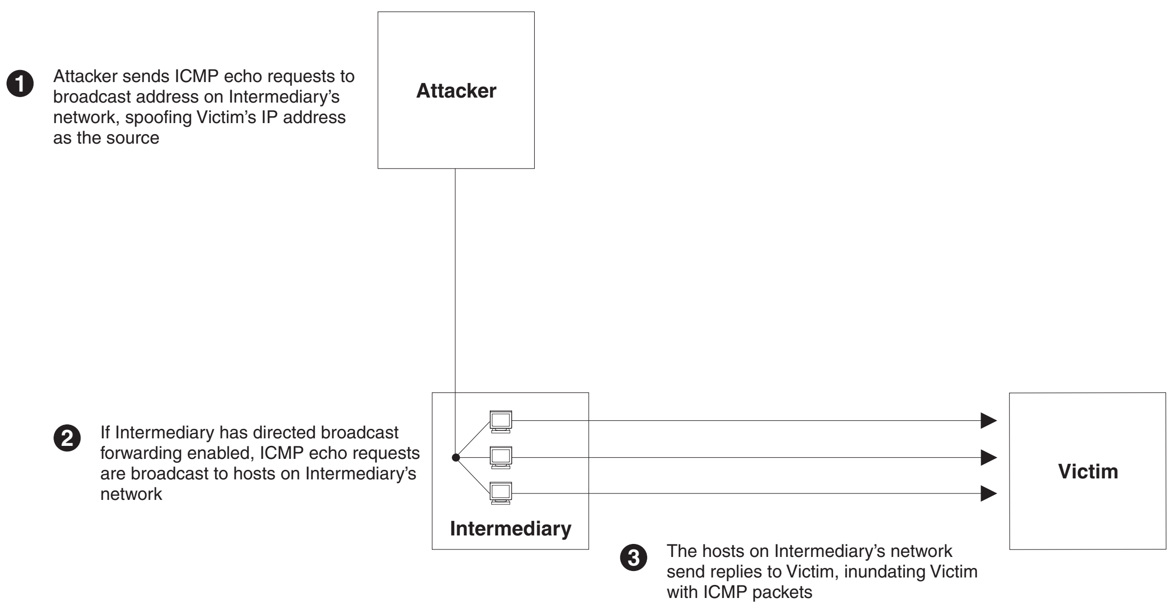


Figure B.1 How a Smurf attack floods a victim with ICMP replies

The attacker sends an ICMP echo request packet to the broadcast address of an intermediary network. The ICMP echo request packet contains the spoofed address of a victim network as its source. When the ICMP echo request reaches the intermediary network, it is converted to a Layer 2 broadcast and sent to the hosts on the intermediary network. The hosts on the intermediary network then send ICMP replies to the victim network.

For each ICMP echo request packet sent by the attacker, a number of ICMP replies equal to the number of hosts on the intermediary network are sent to the victim. If the attacker generates a large volume of ICMP echo request packets, and the intermediary network contains a large number of hosts, the victim can be overwhelmed with ICMP replies.

Avoiding Being an Intermediary in a Smurf Attack

A Smurf attack relies on the intermediary to broadcast ICMP echo request packets to hosts on a target sub-net. When the ICMP echo request packet arrives at the target sub-net, it is converted to a Layer 2 broadcast and sent to the connected hosts. This conversion takes place only when directed broadcast forwarding is enabled on the device.

To avoid being an intermediary in a Smurf attack, make sure forwarding of directed broadcasts is disabled on the HP device. Directed broadcast forwarding is disabled by default. To disable directed broadcast forwarding, do one of the following:

USING THE CLI

```
HP9300(config)# no ip directed-broadcast
```

Syntax: [no] ip directed-broadcast

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the list of configuration options.
3. Click on the plus sign next to IP to display the list of IP configuration options.
4. Select the General link to display the IP configuration panel.
5. Select Disable next to Directed Broadcast Forward.
6. Click the Apply button to save the change to the device’s running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device’s flash memory.

Avoiding Being a Victim in a Smurf Attack

You can configure the HP device to drop ICMP packets when excessive numbers are encountered, as is the case when the device is the victim of a Smurf attack. You can set threshold values for ICMP packets that are targeted at the router itself or passing through an interface, and drop them when the thresholds are exceeded.

For example, to set threshold values for ICMP packets targeted at the router, enter the following command in CONFIG mode:

```
HP9300(config)# ip icmp burst-normal 5000 burst-max 10000 lockup 300
```

To set threshold values for ICMP packets received on interface 3/11:

```
HP9300(config)# int e 3/11
HP9300(config-if-e100-3/11)# ip icmp burst-normal 5000 burst-max 10000 lockup 300
```

Syntax: ip icmp burst-normal <value> burst-max <value> lockup <seconds>

The **burst-normal** value can be from 1 – 100000.

The **burst-max** value can be from 1 – 100000.

The **lockup** value can be from 1 – 10000.

The number of incoming ICMP packets per second are measured and compared to the threshold values as follows:

- If the number of ICMP packets exceeds the **burst-normal** value, the excess ICMP packets are dropped.

- If the number of ICMP packets exceeds the **burst-max** value, *all* ICMP packets are dropped for the number of seconds specified by the **lockup** value. When the lockup period expires, the packet counter is reset and measurement is restarted.

In the example above, if the number of ICMP packets received per second exceeds 5,000, the excess packets are dropped. If the number of ICMP packets received per second exceeds 10,000, the device drops all ICMP packets for the next 300 seconds (five minutes).

Protecting Against TCP SYN Attacks

TCP SYN attacks exploit the process of how TCP connections are established in order to disrupt normal traffic flow. When a TCP connection starts, the connecting host first sends a TCP SYN packet to the destination host. The destination host responds with a SYN ACK packet, and the connecting host sends back an ACK packet. This process, known as a "TCP three-way handshake", establishes the TCP connection.

While waiting for the connecting host to send an ACK packet, the destination host keeps track of the as-yet incomplete TCP connection in a connection queue. When the ACK packet is received, information about the connection is removed from the connection queue. Usually there is not much time between the destination host sending a SYN ACK packet and the source host sending an ACK packet, so the connection queue clears quickly.

In a TCP SYN attack, an attacker floods a host with TCP SYN packets that have random source IP addresses. For each of these TCP SYN packets, the destination host responds with a SYN ACK packet and adds information to the connection queue. However, since the source host does not exist, no ACK packet is sent back to the destination host, and an entry remains in the connection queue until it ages out (after around a minute). If the attacker sends enough TCP SYN packets, the connection queue can fill up, and service can be denied to legitimate TCP connections.

To protect against TCP SYN attacks, you can configure the HP device to drop TCP SYN packets when excessive numbers are encountered. You can set threshold values for TCP SYN packets that are targeted at the router itself or passing through an interface, and drop them when the thresholds are exceeded.

For example, to set threshold values for TCP SYN packets targeted at the router, enter the following command in CONFIG mode:

```
HP9300(config)# ip tcp burst-normal 10 burst-max 100 lockup 300
```

To set threshold values for TCP SYN packets received on interface 3/11:

```
HP9300(config)# int e 3/11
HP9300(config-if-e100-3/11)# ip tcp burst-normal 10 burst-max 100 lockup 300
```

Syntax: ip tcp burst-normal <value> burst-max <value> lockup <seconds>

The **burst-normal** value can be from 1 – 100000.

The **burst-max** value can be from 1 – 100000.

The **lockup** value can be from 1 – 10000.

The number of incoming TCP SYN packets per second are measured and compared to the threshold values as follows:

- If the number of TCP SYN packets exceeds the **burst-normal** value, the excess TCP SYN packets are dropped.
- If the number of TCP SYN packets exceeds the **burst-max** value, *all* TCP SYN packets are dropped for the number of seconds specified by the **lockup** value. When the lockup period expires, the packet counter is reset and measurement is restarted.

In the example above, if the number of TCP SYN packets received per second exceeds 10, the excess packets are dropped. If the number of TCP SYN packets received per second exceeds 100, the device drops all TCP SYN packets for the next 300 seconds (five minutes).

Displaying Statistics about Packets Dropped Because of DoS Attacks

To display information about ICMP and TCP SYN packets dropped because burst thresholds were exceeded:

```
HP9300(config)# show statistics dos-attack

---------------------------- Local Attack Statistics --------------------------
ICMP Drop Count    ICMP Block Count    SYN Drop Count    SYN Block Count
---------------    ----------------    --------------    ---------------
              0                   0                 0                  0
--------------------------- Transit Attack Statistics -------------------------
Port   ICMP Drop Count    ICMP Block Count    SYN Drop Count    SYN Block Count
-----  ---------------    ----------------    --------------    ---------------

3/11                 0                   0                 0                  0
```

Syntax: show statistics dos-attack

To clear statistics about ICMP and TCP SYN packets dropped because burst thresholds were exceeded:

```
HP9300(config)# clear statistics dos-attack
```

Syntax: clear statistics dos-attack

Appendix C
Policies and Filters

The HP 9304M, HP 9308M, and HP 6308M-SX routing switches and the HP 6208M-SX switch provide a robust array of policies and filters. You can configure policies and filters to do the following:

- Change Quality-of-Service priorities for individual ports, VLANs, Layer 4 flows, static MAC entries, and AppleTalk sockets.
- Configure protocol-based VLANs, IP sub-net VLANs, and IPX network VLANs within standard 802.1d port-based VLANs.
- Forward or drop IP packets based on source and destination IP addresses, Layer 4 information (such as TCP or UDP port), or both.
- Learn or drop IP/RIP routes on incoming traffic, based on network address or the IP/RIP neighbor's IP address.
- Control learning and advertisement of IP/RIP routes, based on network address or the IP/RIP neighbor's IP address.
- Forward or drop IPX packets based on source and destination network address and socket information.
- Control learning and advertisement of IPX RIP routes.
- Permit or deny access to IPX servers.
- Permit or deny AppleTalk zone and network information to reach other zones.
- Control learning and advertisement of routes learned from BGP4 neighbors. You can filter based on network address information, AS-path information, and community names.
- Redistribute routes among IP/RIP, OSPF, and BGP4.
- Filter on specific MAC addresses, on Layer 2 multicast packets, and on Layer 2 broadcast packets.

This appendix describes the various types of policies and filters. For each type of policy or filter, the CLI command syntax and the Web management links for configuring the policy or filter are provided. This appendix also refers you to specific configuration procedures.

NOTE: This appendix does not describe Access Control Lists (ACLs) or IPX SAP ACLs, which are additional methods for filtering packets. See "Using Access Control Lists (ACLs)" on page 3-1 and "Configuring IPX SAP Access Control Lists (ACLs)" on page 14-9.

Scope

Some policies and filters are configured and apply globally, while others are configured globally but apply to individual ports. The following table lists the scope for each type of policy and filter.

Table C.1: Scopes of Policies and Filters

Policy or Filter Type	Scope
QoS policy	Configured and applied to one of the following: • Ports • VLANs • Static MAC entries • Layer 4 sessions • AppleTalk sockets
Access policy (see forwarding filters)	See Forwarding filters
Forwarding filters • MAC forwarding filters • IP forwarding filters (same as IP access policy) • IPX forwarding filters • TCP/UDP forwarding filters	Configured globally, then applied locally to a port's inbound or outbound policy or filter group. You can use the same policy or filter in a port's inbound policy or filter group and outbound policy or filter group. You also can use the same policy or filter on multiple ports.
Address-lock filter	Configured and applied on individual ports.
Route filters • IP/RIP route filters • IPX RIP route filters • IPX SAP service filters	Configured globally and applied to individual ports
RIP neighbor filters	Configured and applied globally
AppleTalk zone and network filters	Configured and applied on individual ports.
BGP4 filters • BGP4 address • BGP4 AS-path • BGP4 community	Configured and applied globally and in route maps
Route redistribution filters • IP/RIP • OSPF • BGP4	Configured and applied globally

Default Filter Actions

By default, no policies or filters are defined on the routing switches and switch. The following table lists the default action when no policy or filter is configured and the default action after you configure a policy or filter. For some types of policies and filters, the default action changes once you configure a policy or filter, regardless of the policy or filter's contents.

Table C.2: Default Policy and Filter Actions

Policy or Filter Type	Default action when no policies or filters are configured	Default action after a policy or filter is configured
QoS policy	Queue all packets in normal or 0 priority queue	Queue all packets in normal or 0 priority queue unless explicitly configured for a higher queue
Access policy (see Forwarding filters)	See Forwarding filters	See Forwarding filters
Forwarding filters • MAC forwarding filters • IP forwarding filters (same as IP access policy) • IPX forwarding filters • TCP/UDP forwarding filters	Permit (forward) all packets	Deny (drop) all packets **Note**: The default action for AppleTalk zone and network filters is always permit. To deny all but specific zones, create permit filters for those zones, then create a deny filter and use the "additional zones" value with the filter.
Address-lock filter	Permit (forward) all packets	Permit only those packets whose source MAC addresses have been learned on the port; drop all others
Route filters • IP/RIP route filters • IP/RIP neighbor filters • IPX RIP route filters • IPX SAP service filters • AppleTalk zone and network filters • BGP4 address filters • BGP4 AS-path filters • BGP4 community filters	Permit (learn and advertise) all routes or services	Deny (do not learn or advertise) all routes or services
Route redistribution filter • IP/RIP • OSPF • BGP4	Do not redistribute routes	Do not redistribute routes unless explicitly redistributed by filter **Note**: For IP/RIP and OSPF, you must explicitly enable redistribution. Redistribution is enabled by default in BGP4.
Layer 2 broadcast and multicast filters	Allow outbound broadcasts and multicasts on the specified ports	Drop outbound broadcasts or multicasts on the specified ports

Policy and Filter Precedence

QoS

You can apply QoS policies to individual ports, VLANs, static MAC address, Layer 4 sessions, and AppleTalk sockets. If a port is a member of two or more of these items and has different priorities, the priorities are merged. However, the resulting priority is never lower than the highest priority.

Precedence Among Filters on Different Layers

Generally, the device applies only the type of filter that applies to the traffic. For example, if a packet is a Layer 2 switched packet, then the device evaluates the packet against the port's MAC filters. If a packet is a routed IP packet, the device evaluates the packet against the port's IP access policies.

HP recommends that you do not use filters at different layers on the same port. For example, do not use MAC filters and IP access policies on the same port.

NOTE: You cannot use Layer 2 filters to filter for Layer 4 information. To filter for Layer 4 information, use IP access policies (filters).

NOTE: If you do choose to apply filters for multiple layers to the same port, note that Layer 2 MAC filters can affect the Layer 3 IP traffic that a port permits or denies on multinetted interfaces. A multinetted interface has multiple IP sub-net interfaces on the same port. MAC filters can filter on the Ethertype field. This field includes Layer 3 protocol information and identifies packets as IP packets, ARP packets, and so on.

If you configure a MAC filter, then leave the default action as "deny any", all packets from one of the IP sub-net addresses to another address on the same multinetted interface that do not match the filter are denied. This includes packet types such as IP and ARP. The result is that you have a Layer 2 filter but Layer 3 traffic is dropped. To avoid this, make sure you configure a filter to "permit any" traffic, thus changing the default action to permit for packets that are not denied by the other MAC filters.

Precedence Among Filters on the Same Layer

For most types of filters, a device applies filters based on the order in which you list them in a port's inbound or outbound filter list. For example, if you apply three filters, 3, 2, and 1024 to port 1/1's outbound filter list, the filters are applied in the following order: 3, 2, 1024.

You must configure the policies or filters before you can add them to a policy or filter group.

When you configure a policy or filter group, you must add all the policies or filters at the same time. You cannot edit policy or filter groups. To change a group, you must delete it, then add a new one.

NOTE: The devices apply Layer 2 broadcast and multicast filters in ascending numerical order, beginning with 1.

Policies

A policy is a set of rules that defines how the device handles packets. Table C.3 lists the types of policies you can configure on the routing switches and the switch.

Table C.3: Policies

Policy Type	Supported on...		See page...
	Routing Switch	Switch	
Quality-of-Service (QoS) Policies	X	X	5
Layer 3 Policies			6
Protocol-based VLANs – either forward or drop Layer 3 traffic based on protocol (or, for IP sub-net VLANs and IPX network VLANs, sub-net or network address)	X	X	6
IP access policies – either forward or drop IP packets	X		7
Layer 4 Policies			28
TCP/UDP access policies – either forward or drop packets based on TCP or UDP port	X	X	9

Quality-of-Service Policies

The routing switches and switch support Quality-of-Service (QoS) through implementation of 802.1p/q prioritization. You can configure QoS policies for packets associated with the following items:

- Ports
- VLANs
- Static MAC entries
- Layer 4 sessions
- AppleTalk sockets.

The default queue for all packets is normal (or 0). You can change QoS policy by placing a port, VLAN, static MAC entry, Layer 4 session, or AppleTalk socket into a higher queue. See “Quality of Service (QoS)” on page 2-1 for more information about the QoS algorithm.

Actions

QoS policies place packets in the specified queue for forwarding.

Scope

You can apply QoS policies to individual ports, VLANs, static MAC address, Layer 4 sessions, and AppleTalk sockets. If a port is a member of two or more of these items and has different priorities, the priorities are merged. However, the resulting priority is never lower than the highest priority.

Syntax

Use the following CLI commands or Web management interface panels to configure QoS policies.

Table C.4: QoS Policies

<table>
<tr><th>QoS Scope</th><th>CLI syntax</th><th>Web management links</th></tr>
<tr><td>Individual port</td><td>HP9300(config-if-1/1)# priority <0-7></td><td>Configure->Port</td></tr>
<tr><td>VLAN</td><td>HP9300(config-vlan-8)# priority <0-7></td><td>Configure->VLAN->Port</td></tr>
<tr><td>Static MAC address[a]</td><td>HP9300(config)# static-mac-address <mac-addr> ethernet <portnum> [priority <0-7>] [host-type | router-type]</td><td>Configure->Static Station</td></tr>
<tr><td>Layer 4 session</td><td>HP9300(config)# ip access-policy <num> priority <0-7> <ip-addr> <ip-mask> | any <ip-addr> <ip-mask> | any tcp | udp [<operator> [<tcp/udp-port-num>]]
HP9300(config-if-1/1)# ip access-policy-group in | out <policy-list>
HP9300(config) ip policy <num> priority <0-7> tcp | udp <tcp/udp-port-num> global | local
HP9300(config-if-1/1) ip-policy <num></td><td>Configure->IP->Access Policy
Layer 4 QoS (link from the System configuration panel)</td></tr>
<tr><td>AppleTalk socket</td><td>HP9300(config)# appletalk qos socket <number> priority <0-7></td><td>Configure->IP->AppleTalk ->Socket QoS</td></tr>
</table>

a. You can configure static MAC addresses on the switch but not on the routing switches.

Layer 3 Policies

Layer 3 policies are rules that control transmission and receipt of packets based on Layer 3 routing protocol information in the packets. You can configure the following types of Layer 3 policies:

- Protocol-based VLANs
- IP access policies (same as IP filters)

Protocol-Based VLANs

Within an 802.1d port-based VLAN, you can configure protocol-based VLANs that define Layer 3 broadcast domains for specific protocols. By configuring a port as a member of a protocol VLAN, you establish a forwarding policy for that port.

For example, if you have a port-based VLAN that contains ports 1 – 12, you can configure some or all of the ports in the VLAN as an AppleTalk protocol VLAN. AppleTalk broadcast traffic received on one of the ports in the AppleTalk VLAN is broadcast to the other ports in the AppleTalk VLAN, but not to ports outside the AppleTalk VLAN.

When a port in protocol-based VLAN receives a packet, the device examines the Layer 3 information in the packet to determine whether the packet type is the same as the protocol type of the VLAN.

- If the packet is the same type as the protocol of the VLAN, the device forwards the packet.
- If the packet is another protocol type, the device drops the packet.

For example, when a port in an AppleTalk VLAN receives an AppleTalk packet, the port forwards the packet. The same port drops IPX packets, unless the port also is a member of an IPX VLAN.

IP sub-net and IPX network VLANs are similar, except for these VLAN types the device examines the IP sub-net or IPX network address.

- If the IP sub-net or IPX network address matches the address of the IP sub-net VLAN or IPX network VLAN, the device forwards the packet.
- If the sub-net or network address does not match the VLAN, the device drops the packet.

See “Configuring VLANs” on page 16-1 for VLAN configuration rules and examples.

Actions

A device forwards a packet if its Layer 3 protocol information matches the protocol VLAN’s protocol type, IP sub-net, or IPX network; otherwise, the policy drops the packet.

Scope

The forwarding policy of a port-based VLAN applies only to that VLAN.

Syntax

Use the following CLI commands or Web management interface panels to configure VLAN policies.

Table C.5: VLAN Policies

Scope	CLI syntax	Web management links
VLAN type	HP9300(config)# vlan <vlan-id> by port HP9300(config-vlan-1)# [untagged] ethernet <portnum > [to | ethernet <portnum>]	Configure->VLAN->Port

NOTE: The **untagged** command applies only if you are removing 802.1q tagging from the ports in the VLAN. 802/1q tagging allows a port to be a member of multiple port-based VLANs. Ports in a port-based VLAN are tagged by default. The default tag is 8100 and is a global parameter.

IP Access Policies

IP access policies are rules that determine whether the device forwards or drops IP packets. You create an IP access policy by defining an IP filter, then applying it to an interface. The filter consists of source and destination IP information and the action to take when a packet matches the values in the filter. You can configure an IP filter to permit (forward) or deny (drop) the packet.

You also can configure Layer 4 information in an IP filter. If you configure Layer 4 information, you are configuring a Layer 4 policy. See “TCP/UDP Access Policies” on page C-9.

You can apply an IP filter to inbound or outbound packets. When you apply the filter to an interface, you specify whether the filter applies to inbound packets or outbound packets. Thus, you can use the same filter on multiple interfaces and specify the filter direction independently on each interface.

Figure D.1 shows an example of an inbound IP access policy group applied to port 1 on slot 1 of an HP 9308M routing switch. In this example, packets enter the port from left to right. The first three packets have entered the port and have been permitted or denied. The two packets on the left have not yet entered the port. When they do, they will be permitted. Since the last policy in the group is a “permit any” policy, all packets that do not match another policy are permitted. The “permit any” policy changes the default action to permit.

Inbound IP Access Policy Group for Port 1/1

PolicyID	Action	Source	Destination
3	Deny	209.157.22.26/32	any
17	Deny	209.157.22.14/32	any
34	Deny	209.157.22.69/32	201.21.2.7/32
1024	Permit	any	any

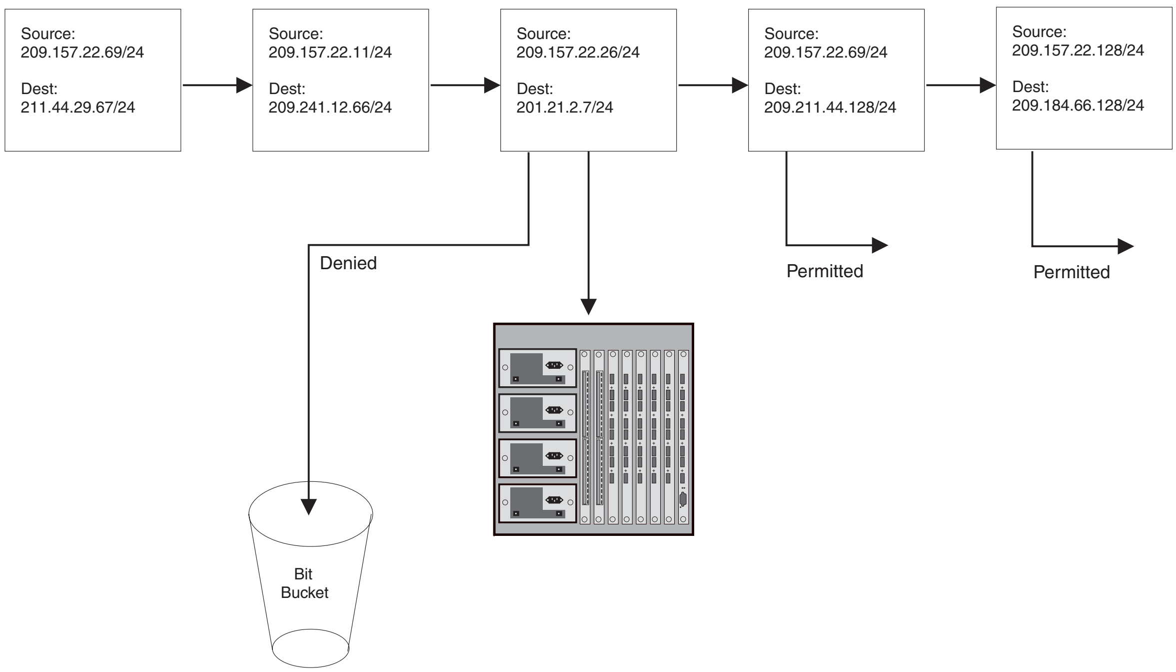


Figure D.1 IP access policies in inbound policy group for a port

Actions

IP access policies either forward or drop IP packets based on the IP source and IP destination addresses. You also can configure the policy to forward or drop a packet based on TCP/UDP port information. In this case, you are configuring a TCP/UDP access policy. See “TCP/UDP Access Policies” on page C-9.

Scope

You configure IP access policies globally, then apply them to individual ports. When you apply an IP policy to a port, you specify whether the policy applies to inbound or outbound packets. You can use the same policy in a port’s inbound policy group and outbound policy group. When you configure a policy group, you must add all the policies to the group at one time. You cannot edit policy groups later. To change a policy group, you must delete the group and then add a new group.

Policies within the group are applied in positional order from left to right. Make sure you specify the filters in the order you want the device to apply them.

Syntax

Use the following CLI commands or Web management interface panels to configure IP access policies.

Table C.6: IP Access Policies

CLI syntax	Web management links
HP9300(config)# ip access-policy <policy-num> permit | deny <ip-addr> <ip-mask> | any <ip-addr> <ip-mask> | any tcp | udp [<operator> [<tcp/udp-port-num>]] [log] HP9300(config-if-1/1)# ip access-policy-group in | out <policy-list>	Configure->IP->Access Policy

Layer 4 Policies

Layer 4 policies are rules that control transmission and receipt of packets based on Layer 4 transport information. You can configure the following types of Layer 4 policies:

- TCP/UDP access policies (same as TCP/UDP filters)

TCP/UDP Access Policies

TCP/UDP access policies are IP filters that contain Layer 4 information. Layer 4 policies enable you to forward or drop packets for individual Layer 4 applications, giving you finer access control. You do not need to completely block an IP address to deny certain types of traffic from that address. You can selectively allow some types of traffic while dropping others. For example, you can configure a Layer 4 policy to drop web (HTTP) packets from a host but allow all other traffic from the host.

You can filter on the following Layer 4 application types:

- ICMP
- IGMP
- IGRP
- OSPF
- TCP
- UDP

For TCP and UDP, you also specify an operator and the port number or well-known name for the port. For example, if you want to filter on FTP traffic, you configure the filter to match on packets that contain the TCP application port number for FTP.

When you can configure a Layer 4 policy, you specify the source and destination IP address of the hosts or servers for which you are controlling access.

Figure D.2 shows an example of TCP/UDP access policies. Although this example does not explicitly identify these policies as inbound policies or outbound policies, when you apply the policies to individual ports you specify whether they are for inbound or outbound traffic.

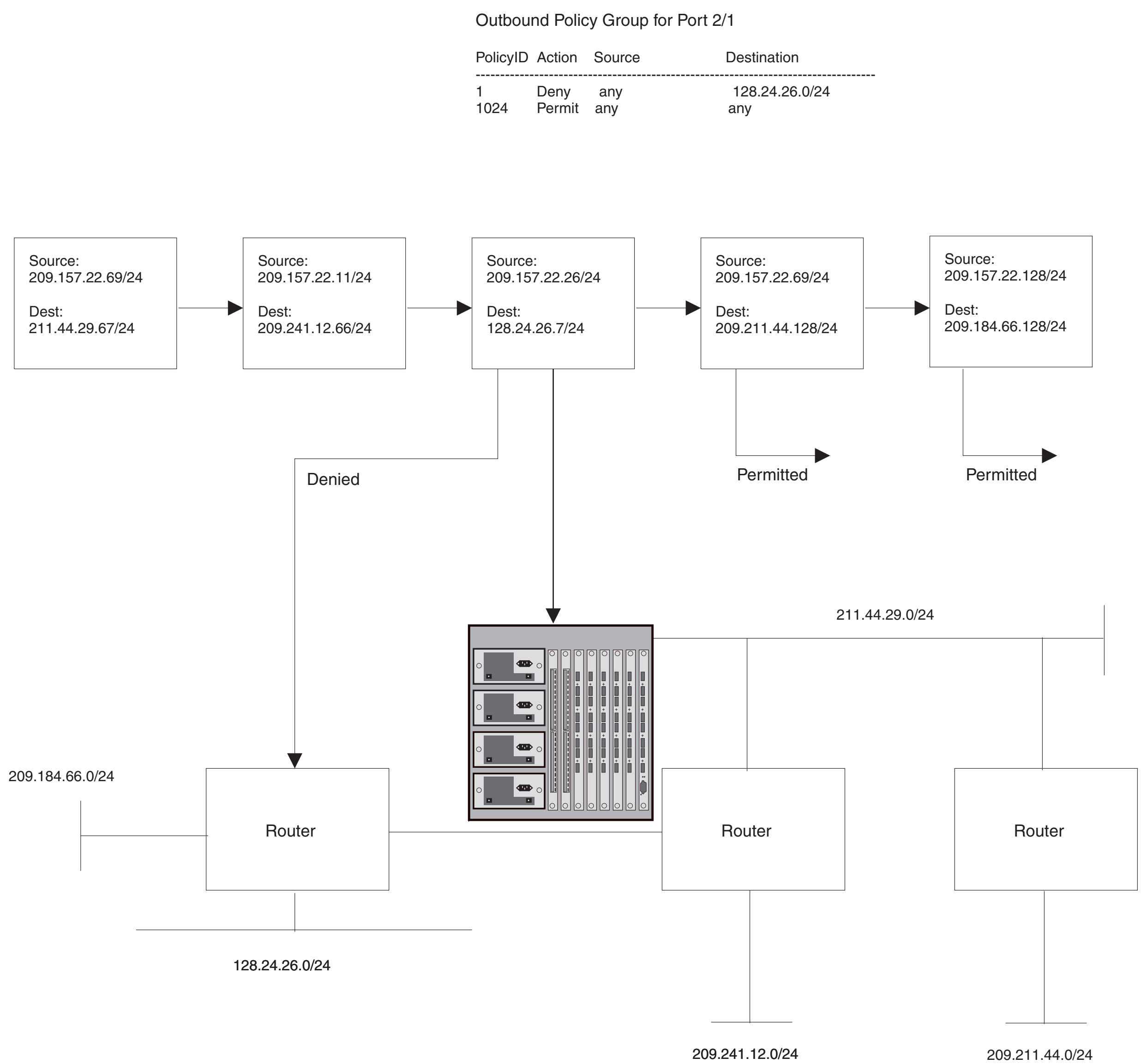


Figure D.2 TCP/UDP Access Policies

Actions

TCP/UDP access policies forward (permit) or drop (deny) IP packets based on the Layer 4 application information in the packets.

Scope

You configure TCP/UDP access policies globally, then apply them to individual ports. When you apply a TCP/UDP policy to a port, you specify whether the policy applies to inbound or outbound packets. You can use the same policy in a port's inbound policy group and outbound policy group. When you configure a policy group, you must add all the policies to the group at one time. You cannot edit policy groups later. To change a policy group, you must delete the group and then add a new group.

Policies within the group are applied in positional order from left to right. Make sure you specify the filters in the order you want the device to apply them.

Syntax

Use the following CLI commands or Web management interface panels to configure TCP/UDP access policies.

Table C.7: TCP/UDP Access Policies

CLI syntax	Web management links
HP9300(config)# ip access-policy <policy-num> permit | deny <ip-addr> <ip-mask> | any <ip-addr> <ip-mask> | any tcp | udp [<operator> [<tcp/udp-port-num>]] [log] HP9300(config-if-1/1)# ip access-policy-group in | out <policy-list> HP9300(config) ip policy <num> priority <0-7> tcp | udp <tcp/udp-port-num> global | local HP9300(config-if-1/1) ip-policy <num>	Configure->IP->Access Policy

Filters

A filter is a set of comparison values and an action. If a packet matches the set of values in the filter, the device takes the action specified in the filter. The routing switches and switch provide filters for Layer 2, Layer 3, and Layer 4. A filter looks at the appropriate fields in a packet to compare information related to one of the layers. For example, MAC filters look at the source and destination MAC address and, optionally, at the encapsulation information. IPX filters look at the source and destination network and socket information but do not look at the MAC information.

The following table lists the various types of filters you can configure on the routing switches and the switch.

Table C.8: Filters

Filter Type	Supported on...		See page...
	Routing Switch	Switch	
Layer 2 Filters			12
MAC filters	X	X	12
Broadcast filters	X	X	13
Multicast filters	X	X	14
Address-lock filters	X	X	14
Layer 3 Filters			16
IP forwarding filters (same as IP access policies)	X		7
IP/RIP route filters	X		16
IP/RIP neighbor filters	X		17
IPX forwarding filters	X		19
IPX RIP filters	X		19
IPX SAP filters	X		20

Table C.8: Filters (Continued)

Filter Type	Supported on...		See page...
	Routing Switch	Switch	
AppleTalk zone filters	X		21
AppleTalk network filters	X		22
BGP address filters	X		22
BGP AS-path filters	X		23
BGP community filters	X		24
IP/RIP redistribution filters	X		26
OSPF redistribution filters	X		27
BGP redistribution filters	X		27
Layer 4 Filters			28
TCP/UDP forwarding filters (same as TCP/UDP access policies)	X	X	9

Layer 2 Filters

Layer 2 filters control a device's receipt of packets based on MAC address information. The routing switches and switch provide the following types of Layer 2 filters:

- MAC address filters
- Address-lock filters

MAC Filters

MAC filters forward or drop incoming packets based on the following information:

- Source MAC address
- Destination MAC address
- Encapsulation type and EtherType (optional)

A packet whose Layer 2 information matches the filter is either permitted (forwarded) or denied (dropped). You define a MAC filter on the global level, then apply it to an interface. MAC filters apply only to incoming packets.

Action

MAC filters forward (permit) or drop (deny) packets.

Scope

You configure MAC filters globally, then apply them to individual ports. The filters do not take effect until applied to specific ports.

Syntax

Use the following CLI commands or Web management interface panels to configure MAC filters.

Table C.9: MAC Filters

CLI syntax	Web management links
HP9300(config)# mac filter <filter-num> permit | deny any | <H.H.H> any | <H.H.H> etype | llc | snap <operator> <frame-type> HP9300(config-if-1/1)# mac-filter-group <filter-list>	Configure->MAC Filter

Broadcast Filters

Broadcast filters are outbound filters that drop Layer 2 broadcast packets that match the filter criteria. You can filter on all broadcast traffic or on IP UDP broadcast traffic only. You also can specify a VLAN ID so that broadcasts are dropped only for the specified VLAN.

You can configure up to eight broadcast filters.

NOTE: Broadcast filters are applied in numerical order, beginning with filter 1.

Action

Broadcast filters forward (permit) or drop (deny) packets.

Scope

You configure broadcast filters globally, then apply them to individual ports. The filters do not take effect until applied to specific ports. The filters apply only to outbound traffic. The **exclude-ports** command specifies the ports on which you are excluding the filtered multicast packets.

Syntax

Use the following CLI commands or Web management interface panels to configure broadcast filters.

Table C.10: Broadcast Filters

CLI syntax	Web management links
HP9300(config)# broadcast filter <filter-id> any | ip udp [vlan <vlan-id>] exclude-ports ethernet <portnum> to <portnum> Or exclude-ports ethernet <portnum> ethernet <portnum>	Not available

NOTE: This is the same command syntax as that used for configuring port-based VLANs. Use the first command for adding a range of ports. Use the second command for adding separate ports (not in a range). You also can combine the syntax. For example, you can enter **exclude-ports ethernet 1/4 ethernet 2/6 to 2/9**.

Multicast Filters

Multicast filters are outbound filters that apply to packets that have a Layer 2 multicast address in the destination MAC address field. You can configure multicast filters to filter on all multicast addresses or a specific multicast address.

You can configure up to eight multicast filters.

NOTE: Multicast filters are applied in numerical order, beginning with filter 1.

Action

Multicast filters forward (permit) or drop (deny) packets.

Scope

You configure multicast filters globally, then apply them to individual ports. The filters do not take effect until applied to specific ports. The filters apply only to outbound traffic. The **exclude-ports** command specifies the ports on which you are excluding the filtered multicast packets.

Syntax

Use the following CLI commands or Web management interface panels to configure multicast filters.

Table C.11: Multicast Filters

CLI syntax	Web management links
HP9300(config)# multicast filter <filter-id> any | ip udp mac <multicast-address> | any [mask <mask>] [vlan <vlan-id>] exclude-ports ethernet <portnum> to <portnum> Or exclude-ports ethernet <portnum> ethernet <portnum>	Not available

NOTE: This is the same command syntax as that used for configuring port-based VLANs. Use the first command for adding a range of ports. Use the second command for adding separate ports (not in a range). You also can combine the syntax. For example, you can enter **exclude-ports ethernet 1/4 ethernet 2/6 to 2/9**.

Address-Lock Filters

Address-lock filters limit the number of MAC addresses that can be learned on a port. The port forwards only those packets that contain one of the source MAC addresses learned by the port. The port drops other packets. In addition, the device generates an SNMP trap for other packets received by the port.

Figure D.3 shows an example of an address-lock filter. In this example, the device is configured to learn only two MAC addresses on port 1/1. After the device learns two addresses, port 1/1 can forward only a packet whose source address is one of the two learned addresses. The port drops all other packets. This applies even to MAC broadcasts. If one of the packets learned on the port is not addressed to the MAC broadcast address, the port cannot forward MAC broadcasts.

The device learns MAC addresses from the source-MAC-address field of inbound packets received on the port.

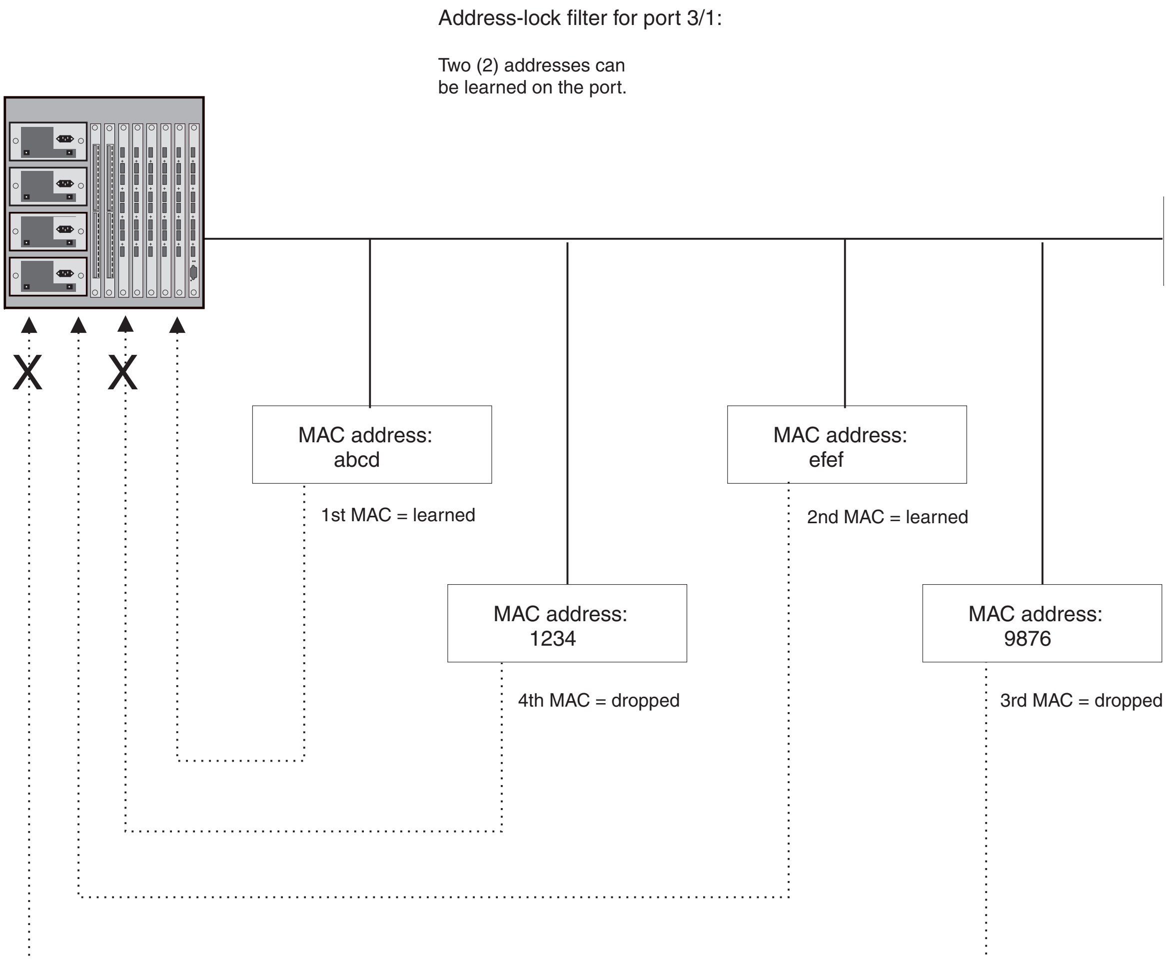


Figure D.3 Address-lock filter

Actions

Forward (permit) only those packets with a MAC address that the port has learned. Deny all other packets.

Scope

You configure a lock address filter globally, but you also specify the port as part of the filter.

Syntax

Use the following CLI commands or Web management interface panels to configure lock-address filters.

Table C.12: Lock-Address Filters

CLI syntax	Web management links
HP9300(config)# lock-address ethernet <portnum> addr-count <num>	Configure->Port

Layer 3 Filters

Layer 3 filters control a device's transmission and receipt of packets based on routing protocol information in the packets. The routing switches and switch provide the following types of Layer 3 filters:

- IP forwarding filters (same as IP access policies, see "IP Access Policies" on page C-7)
- IP/RIP route filters
- IP/RIP neighbor filters
- IPX forwarding filters
- IPX RIP route and neighbor filters
- IPX SAP service filters
- AppleTalk zone filters
- AppleTalk network filters
- BGP route address filters
- BGP route AS-path filters
- BGP route community filters
- IP/RIP redistribution filters
- OSPF redistribution filters
- BGP redistribution filters

IP Filters

IP filters control the IP packets that the device sends and receives and the routes that the device learns or advertises. IP forwarding filters (IP Access policies) control transmission and receipt of IP packets, while IP/RIP route and neighbor filters control the routes that the device leans or advertises. Route filters filter on specific network addresses while neighbor filters filter on the IP addresses of the IP/RIP neighbors.

IP Forwarding Filters

IP forwarding filters determine whether to forward or drop an IP packet. IP forwarding filters on a switch or routing switch are called "IP access policies". See "IP Access Policies" on page C-7.

IP/RIP Route Filters

IP/RIP route filters control the routes that a device learns and advertises. Figure D.4 shows an example of a port with IP/RIP route filters. The port has filters for the inbound direction and the outbound direction. Notice that the same filter can be used for both directions. The inbound filters control the routes that the device learns; denied routes are not learned by the device. Outbound filters control the routes that the device advertises; denied routes are not advertised to RIP neighbors.

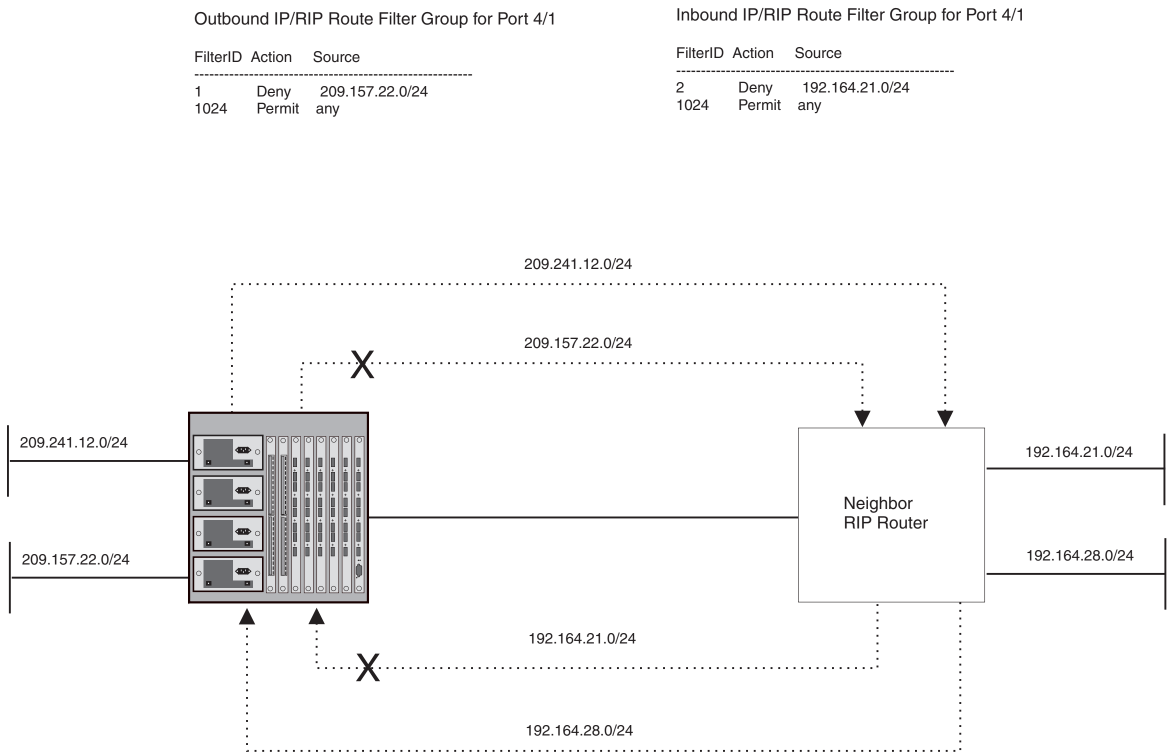


Figure D.4 IP/RIP route filters

Actions

- An IP/RIP route filter applied to outbound traffic on a port permits or denies advertisement of routes.
- An IP/RIP route filter applied to inbound traffic on a port permits or denies learning of the route. When the device learns an IP/RIP route, the route is added to the IP/RIP route table.

Scope

You configure IP/RIP route filters globally, then apply them to specific ports.

Syntax

Use the following CLI commands or Web management interface panels to configure IP/RIP route filters.

Table C.13: IP/RIP Route Filters

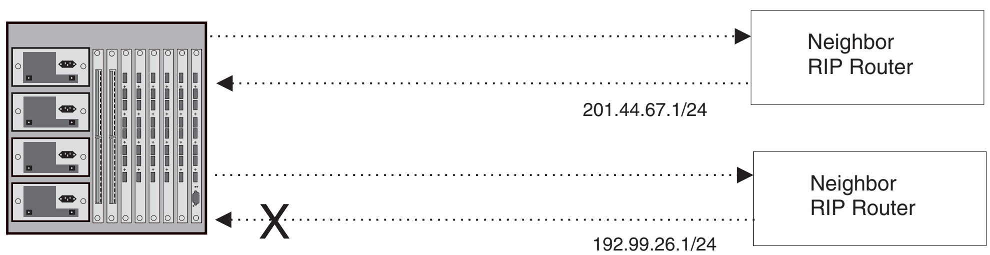
CLI syntax	Web management links
HP9300(config-rip-router)# filter <filter-num> permit | deny <source-ip-address> | any <source-mask> | any HP9300(config-if-1/1)# ip rip filter-group in | out <filter-list>	Configure->RIP->Route Filter

IP/RIP Neighbor Filters

IP/RIP neighbor filters specify the IP/RIP neighbors the device can receive updates from or send updates to. You identify the neighbor by specifying its IP address in the filter. Figure D.5 shows an example of an IP/RIP neighbor filter. In this example, the device is configured to drop all IP/RIP advertisements from the IP/RIP neighbor 192.99.26.1/24. Since this is an outbound filter, the filter does not affect advertisements received by the device from 192.99.26.1/24. The device can still learn IP/RIP routes from this neighbor.

```
Inbound IP/RIP Neighbor Filter for Port 4/3

FilterID  Action    Source
--------------------------------------------------------
1         Deny      192.99.26.1/24
1024      Permit    any
```



Actions

- An IP/RIP neighbor filter applied to outbound traffic on a port permits or denies advertisement of routes.
- An IP/RIP neighbor filter applied to inbound traffic on a port permits or denies learning of the routes advertised by the neighbor. When the device learns an IP/RIP route, the route is added to the IP/RIP route table.

Scope

You configure IP/RIP neighbor filters globally. They are automatically applied to all RIP ports as soon as you configure them.

Syntax

Use the following CLI commands or Web management interface panels to configure IP/RIP neighbor filters.

Table C.14: IP/RIP Neighbor Filters

<table>
<tr><th>CLI syntax</th><th>Web management links</th></tr>
<tr><td>HP9300(config-rip-router)# neighbor <filter-num> permit | deny <source-IP-address> | any</td><td>Configure->RIP->Neighbor Filter</td></tr>
</table>

IPX Filters

IPX filters control transmission and receipt of IPX packets, IPX RIP routes, and IPX Service Advertisement Protocol (SAP) messages. IPX forwarding filters filter on source and destination IPX address and socket information. IPX RIP filters filter based on a route's network address. IPX SAP filters filter based on server type and server name.

IPX Forwarding Filters

IPX forwarding filters control forwarding of IPX packets.

Action

- An IPX forward filter applied to inbound packets forwards or drops IPX packets received on the port.
- An IPX forward filter applied to outbound traffic forward or drops IPX packets sent to the port for forwarding.

Scope

You configure IPX forwarding filters globally, then apply them to specific ports.

Syntax

Use the following CLI commands or Web management interface panels to configure IPX forwarding filters.

Table C.15: IPX Forwarding Filters

CLI syntax	Web management links
HP9300(config)# ipx forward-filter <filter-num> permit | deny <source-network-number> | any <source-node-number> | any <destination-network-number> | any <destination-node-number> | any <destination-socket-number> | any HP9300(config-if-1/1)# ipx forward-filter-group in | out <filter-list>	Configure->IPX->Forward Filter

IPX RIP Filters

IPX RIP filters control the IPX routes that the device learns or advertises.

Actions

- An IPX RIP filter applied to inbound packets learns or drops IPX routes received on the port.
- An IPX RIP filter applied to outbound packets advertises or does not advertise IPX routes.

Scope

You configure IPX RIP filters globally, then apply them to specific ports.

Syntax

Use the following CLI commands or Web management interface panels to configure IPX RIP filters.

Table C.16: IPX RIP Filters

CLI syntax	Web management links
HP9300(config)# ipx rip-filter <filter-num> permit | deny <network-number> | any <network-mask> | any HP9300(config-if-1/1)# ipx rip-filter-group in | out <filter-list>	Configure->IPX->RIP Filter

IPX SAP Filters

IPX Service Advertisement Protocol (SAP) filters control client access to IPX servers.

Actions

- An IPX SAP filter applied to inbound packets learns or drops advertisements for the specific services.
- An IPX SAP filter applied to outbound traffic advertises or does not advertise services.

Scope

You configure IPX SAP filters globally, then apply them to specific ports.

Syntax

Use the following CLI commands or Web management interface panels to configure IPX SAP filters.

Table C.17: IPX SAP Filters

CLI syntax	Web management links
HP9300(config)# ipx sap-filter <filter-num> permit | deny <server-type> | any <server-name> | any HP9300(config-if-1/1)# ipx sap-filter-group in | out <filter-list>	Configure->IPX->SAP Filter

Appletalk Filters

AppleTalk filters control access to AppleTalk zones and networks.

- AppleTalk zone filters permit or deny advertisement of zone names but allow network information to be learned and forwarded. Users cannot see the zone names in their Choosers but you can ping the networks. Zone filters are quite useful for reducing protocol overhead caused by “chatty” AppleTalk traffic. Use zone filtering to block information from a specific routing switch to Macintosh computers.
- AppleTalk network filters also can filter network information. When you configure an AppleTalk zone filter to deny zones, you can configure the filter to also deny the network information. To configure an AppleTalk filter to filter network information, use the RTMP filtering option with the filter.

Figure D.6 shows an example of an AppleTalk zone filter. In this example, Macintosh computers in the Marketing zone cannot see the Engineering zone. RTMP filtering is not used on this filter. Therefore, users in the Marketing zone can still ping individual devices in the Engineering zone. However, the overhead caused by unnecessary zone information exchanges between the two groups is eliminated.

To prevent users in the Marketing zone from even pinging individual devices in the Engineering zone, the RTMP filtering option can be used with the filter.

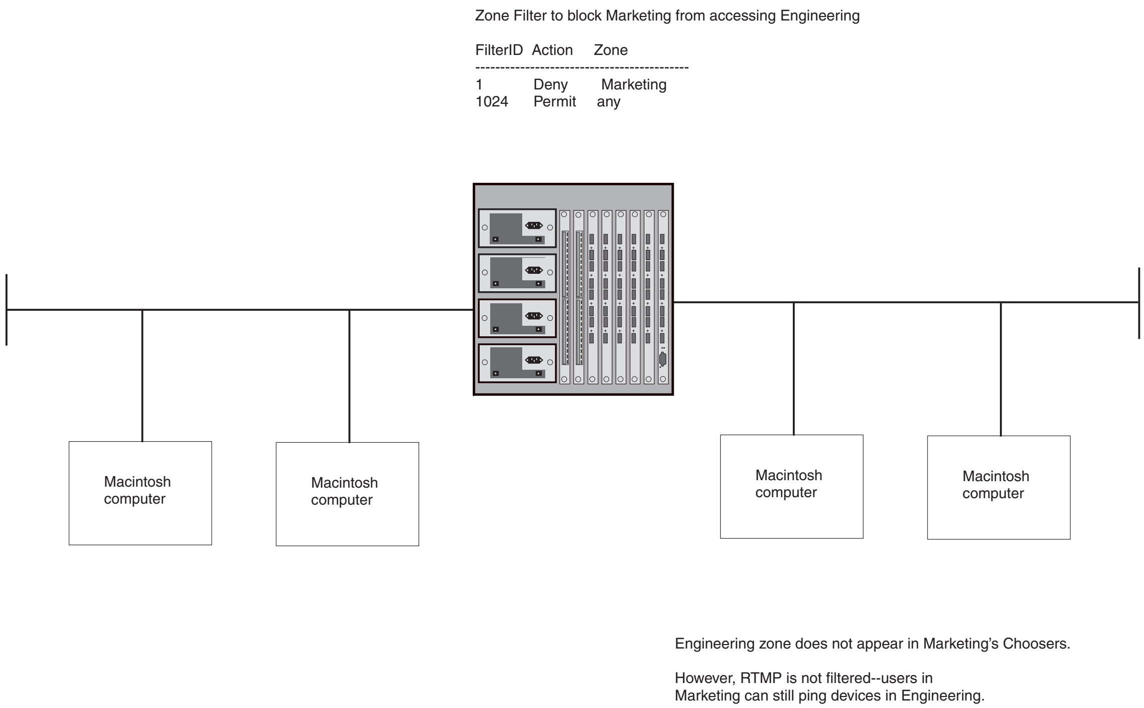


Figure D.6 AppleTalk zone filter

Appletalk Zone Filters

AppleTalk zone filters let you secure access to an AppleTalk zone. The filter controls whether the routing switch includes the zone in replies to a MAC chooser's ZIP GetZoneList request.

Actions

An AppleTalk zone filter permits (advertises) or denies (does not advertise) the specified zone. The zone does not appear in MAC user's choosers but you can still ping the networks that belong to the zone.

NOTE: Unlike other filters, the default action for AppleTalk filters does not change from permit to deny when you create a filter. To permit only specific zones and deny all others, create permit filters for the zones you want to permit, then use the following command to create a deny filter for all other zones:
appletalk deny zone additional-zones.

Scope

You configure and apply AppleTalk zone filters on individual ports.

Syntax

Use the following CLI commands or Web management interface panels to configure AppleTalk zone filters.

Table C.18: AppleTalk Zone Filters

CLI syntax	Web management links
HP9300(config-if-1/1)# appletalk permit zone <string>	Configure->AppleTalk->Zone Filter
HP9300(config-if-1/1)# appletalk deny zone <string> | additional-zones rtmp-filtering | no-rtmp-filtering	Configure->AppleTalk->Additional Zone Filter

NOTE: If you use the **rtmp-filtering | no-rtmp-filtering** parameter, you are configuring an AppleTalk network filter. See the following section.

Appletalk Network Filters

Routing Table Maintenance Protocol (RTMP) filtering enhances a zone filter by hiding the cable ranges inside the zones used by other routing switches. The denied network numbers of the filtered zone will be removed from the RTMP packets.

The Macintosh chooser uses ZIP GetZoneList request to compile a list of zones available, so if the zone is not there the Macintosh computer cannot access it. RTMP filtering is useful for preventing downstream and adjacent routers from responding to GetZoneList requests that could give access to the zones you want to filter. All routing switches on the same segment should be configured with the same filters. You can prevent local Macintosh computers from accessing a zone but still allow the downstream routers with Macintosh computers attached to other networks to access those zones. To do so, do not use the RTMP filtering option with the zone filter.

When you configure an AppleTalk zone filter to also filter network information, the device removes route information for the networks in the specified zone before sending the RTMP packet out on the port.

Actions

AppleTalk network filters remove information about the networks in the denied zones before sending RTMP packets to Macintosh computers.

NOTE: AppleTalk network filters only deny information; they do not permit information.

Scope

You configure and apply AppleTalk network filters on individual ports.

Syntax

Use the following CLI commands or Web management interface panels to configure AppleTalk zone filters.

Table C.19: AppleTalk Zone Filters

CLI syntax	Web management links
HP9300(config-if-1/1)# appletalk permit zone <string>	Configure->AppleTalk->Zone Filter
HP9300(config-if-1/1)# appletalk deny zone <string> | additional-zones rtmp-filtering | no-rtmp-filtering	Configure->AppleTalk->Additional Zone Filter

NOTE: If you do not use the **rtmp-filtering | no-rtmp-filtering** parameter, you are configuring an AppleTalk zone filter.

BGP4 Filters

Border Gateway Protocol version 4 (BGP4) filters control the routes that a device learns from BGP4 neighbors and advertises to BGP4 neighbors. You can configure filters to filter route information based on network address, AS-path, or community name.

BGP4 Address Filters

BGP4 address filters control whether the device learns or drops BGP4 route information based on the route’s network address.

Actions

- A BGP4 address filter applied to inbound packets permits (learns) or denies (drops) the specified network address in BGP4 updates received from a BGP4 neighbor.
- A BGP4 address filter applied to outbound packets permits (advertises) or denies (drops) the specified network address in BGP4 updates the device sends to a BGP4 neighbor.

Scope

You define BGP4 address filters globally, then apply them as part of a BGP4 neighbor's distribute list or as part of a match statement in a route map.

Syntax

Use the following CLI commands or Web management interface panels to configure BGP4 address filters.

Table C.20: BGP4 Address Filters

CLI syntax	Web management links
HP9300(config-bgp-router)# address-filter <num> permit | deny <ip-addr> <ip-mask> | any <ip-addr> <ip-mask> | any	Configure->BGP->Address Filter
HP9300(config-bgp-router)# neighbor <router-id> remote-as <as-number> [advertisement-interval <num>] [distribute-list in | out <num,num,...>] [ebgp-multihop] [filter-list in | out <num,num,...>] [maximum-prefix <num>] [next-hop-self] [remote-as <as-number>] [route-map <map-name>] [send-community] [weight <num>]	Configure->BGP->Neighbor
HP9300(config-bgp-routemap RMAP_NAME)# match as-path-filters | community-filters | address-filters <num,num,...> [metric <num>] [next-hop <ip-addr>] [route-type internal | external-type1 | external-type2] [tag <tag-value>]	Configure->BGP->Route Map Filter

NOTE: The **neighbor** command adds a BGP neighbor. The **distribute-list** parameter specifies a list of address filters and whether the list is applied to inbound or outbound BGP updates.

NOTE: The **match** command compares the information you configure for the command's parameters against BGP routes. You use this command when configuring a route map. If the comparison matches a route, set statements in the route map specify the action to take. See "Defining Route Maps" on page 10-59.

BGP4 AS-Path Filters

BGP4 AS-path filters control whether the device learns or drops BGP4 route information based on the route's AS-path. The ***AS-path*** is the list of BGP4 autonomous systems (ASs) through which the route information has traveled to reach the device.

Actions

- A BGP4 AS-path filter applied to inbound packets permits (learns) or denies (drops) routes for networks with the specified AS-path in BGP4 updates received from a BGP4 neighbor.
- A BGP4 AS-path filter applied to outbound packets permits (advertises) or denies (drops) routes for networks with the specified AS-path in BGP4 updates sent to a BGP4 neighbor.

Scope

You define BGP4 AS-path filters globally, then apply them as part of a BGP4 neighbor’s distribute list or as part of a match statement in a route map.

Syntax

Use the following CLI commands or Web management interface panels to configure BGP4 AS-path filters.

Table C.21: BGP4 AS-Path Filters

CLI syntax	Web management links
HP9300(config-bgp-router)# as-path-filter <num> permit | deny <as-path>	Configure->BGP->AS Path Filter
HP9300(config-bgp-router)# neighbor <router-id> remote-as <as-number> [advertisement-interval <num>] [distribute-list in | out <num,num,...>] [ebgp-multihop] [filter-list in | out <num,num,...>] [maximum-prefix <num>] [next-hop-self] [remote-as <as-number>] [route-map <map-name>] [send-community] [weight <num>]	Configure->BGP->Neighbor
HP9300(config-bgp-routemap RMAP_NAME)# match as-path-filters | community-filters | address-filters <num,num,...> [metric <num>] [next-hop <ip-addr>] [route-type internal | external-type1 | external-type2] [tag <tag-value>]	Configure->BGP->Route Map Filter

NOTE: The <as-path> value can be a regular expression. See “Using Regular Expressions” on page 10-49.

NOTE: The **neighbor** command adds a BGP neighbor. The **filter-list** parameter specifies a list of AS-path filters and whether the list is applied to inbound or outbound BGP updates.

NOTE: The **match** command compares the information you configure for the command’s parameters against BGP routes. You use this command when configuring a route map. If the comparison matches a route, set statements in the route map specify the action to take. See “Defining Route Maps” on page 10-59.

BGP4 Community Filters

BGP4 community filters control whether the device learns or drops BGP4 route information based on the route’s community membership.

Actions

- A BGP4 community filter applied to inbound packets permits (learns) or denies (drops) routes for networks with the specified community membership in BGP4 updates received from a BGP4 neighbor.
- A BGP4 AS-path filter applied to outbound packets permits (advertises) or denies (drops) routes for networks with the specified community membership in BGP4 updates sent to a BGP4 neighbor.

Scope

You define BGP4 community filters globally, then apply them as part of a BGP4 neighbor's distribute list or as part of a match statement in a route map.

Syntax

Use the following CLI commands or Web management interface panels to configure BGP4 community filters.

Table C.22: BGP4 Community Filters

CLI syntax	Web management links
HP9300(config-bgp-router)# community-filter <filter-num> permit | deny <num> | internet | no-advertise | no-export	Configure->BGP->Community Filter
HP9300(config-bgp-routemap RMAP_NAME)# match as-path-filters | community-filters | address-filters <num,num,...> [metric <num>] [next-hop <ip-addr>] [route-type internal | external-type1 | external-type2] [tag <tag-value>]	Configure->BGP->Route Map Filter

NOTE: The **match** command compares the information you configure for the command's parameters against BGP routes. You use this command when configuring a route map. If the comparison matches a route, set statements in the route map specify the action to take. See "Defining Route Maps" on page 10-59.

Redistribution Filters

Redistribution filters control the exchange of routes between routing protocols. IP/RIP, OSPF, and BGP4 support redistribution of one another's routes. In addition, they all allow exchange of static routes.

You configure IP/RIP and OSPF redistribution filters to permit or deny routes for specific network addresses. Optionally, you can also filter on and modify the route metric. To configure redistribution, you configure redistribution filters in the protocol that will receive the routes. Redistribution is disabled by default in RIP and OSPF and enabled by default in BGP4.

BGP4 redistribution filters can filter based on a route's metric, weight, and also on the results of comparison of the route information with a route map. A ***route map*** is a named set of match conditions and parameter settings that a routing switch can use to modify route attributes and to control redistribution of routes. For more information, see "Defining Route Maps" on page 10-59.

BGP4 allows you to include the redistribution filters as part of a route map. A route map examines and modifies route information exchanged between BGP4 and IP/RIP or OSPF. See "Configuring BGP4" on page 10-1 for more information.

Figure D.7 shows an example of a redistribution filter. In this example, redistribution filters in OSPF are configured to redistribute two RIP routes into OSPF. Notice that unlike some other filter examples in this appendix, a filter for permitting all routes (to change the default action) is not configured. To maintain tight control over redistribution, the default action "deny any" is allowed to remain. Only routes that explicitly match the permit filters are permitted to be redistributed. Thus, in Figure D.7, the RIP route to 191.47.12.0/24 is not redistributed because there is no "permit any" filter that changes the default action from deny to permit.

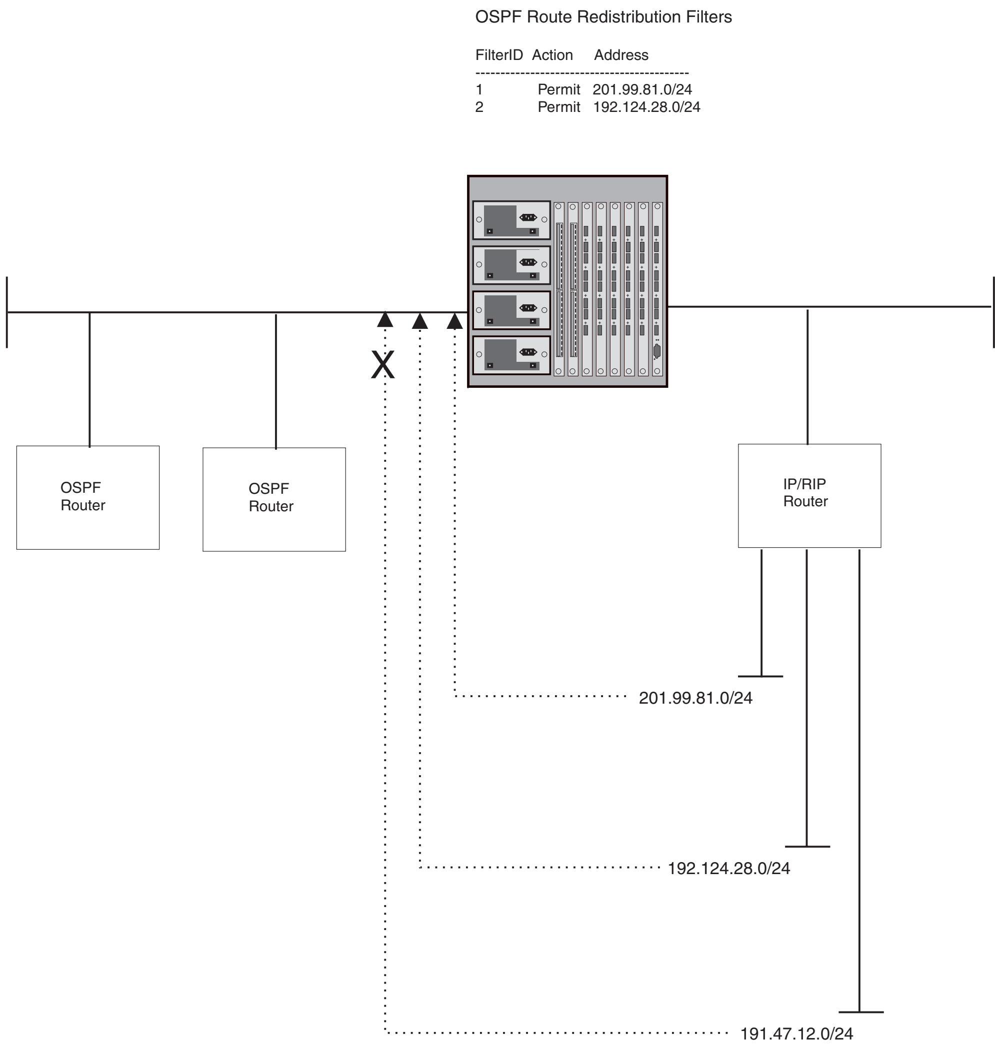


Figure D.7 OSPF redistribution filters

IP/RIP Redistribution Filters

IP/RIP redistribution filters control redistribution of routes from other protocols into RIP. A device running RIP can redistribute static routes, OSPF routes, and BGP4 routes (if BGP4 is supported on the device) into RIP.

Optionally, you can specify a metric that the route must match or you can set the metric on redistributed routes. By setting the metric, you can cause the routing switch to prefer IP/RIP routes or redistributed routes to the specified network.

Actions

IP/RIP redistribution filters permit (redistribute) or deny (do not redistribute) OSPF or BGP4 routes into IP/RIP.

Scope

You configure IP/RIP redistribution filters globally. They are automatically applied as soon as you configure them.

Syntax

Use the following CLI commands or Web management interface panels to configure IP/RIP redistribution filters.

Table C.23: IP/RIP Redistribution Filters

CLI syntax	Web management links
HP9300(config-rip-router)# permit | deny redistribute <filter-num> all | bgp | ospf | static <ip-addr> <ip-mask> [match-metric <value> | set-metric <value>]	Configure->RIP->Redistribution Filter

OSPF Redistribution Filters

OSPF redistribution filters control redistribution of routes from other protocols into OSPF. A device running OSPF can redistribute static routes, IP/RIP routes, and BG4P routes (if BGP4 is supported on the device) into OSPF.

Optionally, you can specify a metric that the route must match or you can set the metric on redistributed routes. By setting the metric, you can cause the routing switch to prefer OSPF routes or redistributed routes to the specified network.

Actions

OSPF redistribution filters permit (redistribute) or deny (don't redistribute) IP/RIP or BGP4 routes into OSPF.

Scope

You configure and apply OSPF redistribution filters globally.

Syntax

Use the following CLI commands or Web management interface panels to configure OSPF redistribution filters.

Table C.24: OSPF Redistribution Filters

CLI syntax	Web management links
HP9300(config-ospf-router)# deny | permit redistribute <filter-num> all | bgp | rip | static address <ip-addr> [match-metric <value> | set-metric <value>]	Configure->OSPF->Redistribution Filter

BGP4 Redistribution Filters

BGP4 redistribution filters control redistribution of routes from other protocols into BGP4. A device running BGP4 can redistribute static routes, IP/RIP routes, and OSPF routes into BGP4.

Optionally, you can modify a route's metric and weight and use a route map to change additional attributes of the route.

Actions

BGP4 redistribution filters permit (redistribute) or deny (don't redistribute) IP/RIP or OSPF routes into IP/RIP.

Scope

You configure and apply BGP4 redistribution filters globally.

Syntax

Use the following CLI commands or Web management interface panels to configure BGP4 redistribution filters.

Table C.25: BGP4 Redistribution Filters

CLI syntax	Web management links
HP9300(config-bgp-router)# redistribute rip | ospf | static [match internal | external1 | external2] [metric <num>] [route-map <name>] [weight <num>]	Configure->BGP->Redistribute

NOTE: The optional **match internal | external1 | external2** argument applies only to OSPF.

Layer 4 Filters

Layer 4 filters control IP traffic based on the Layer 3 and Layer 4 information in the packets. On switches and routing switches, Layer 4 filters are access policies that control access to Layer 4 applications based on TCP/UDP or other port number.

TCP/UDP Forwarding Filters

TCP/UDP forwarding filters are the same as TCP/UDP access policies. See "TCP/UDP Access Policies" on page C-9.

Index

I

S

invent

Manual Part Number
5969-2363